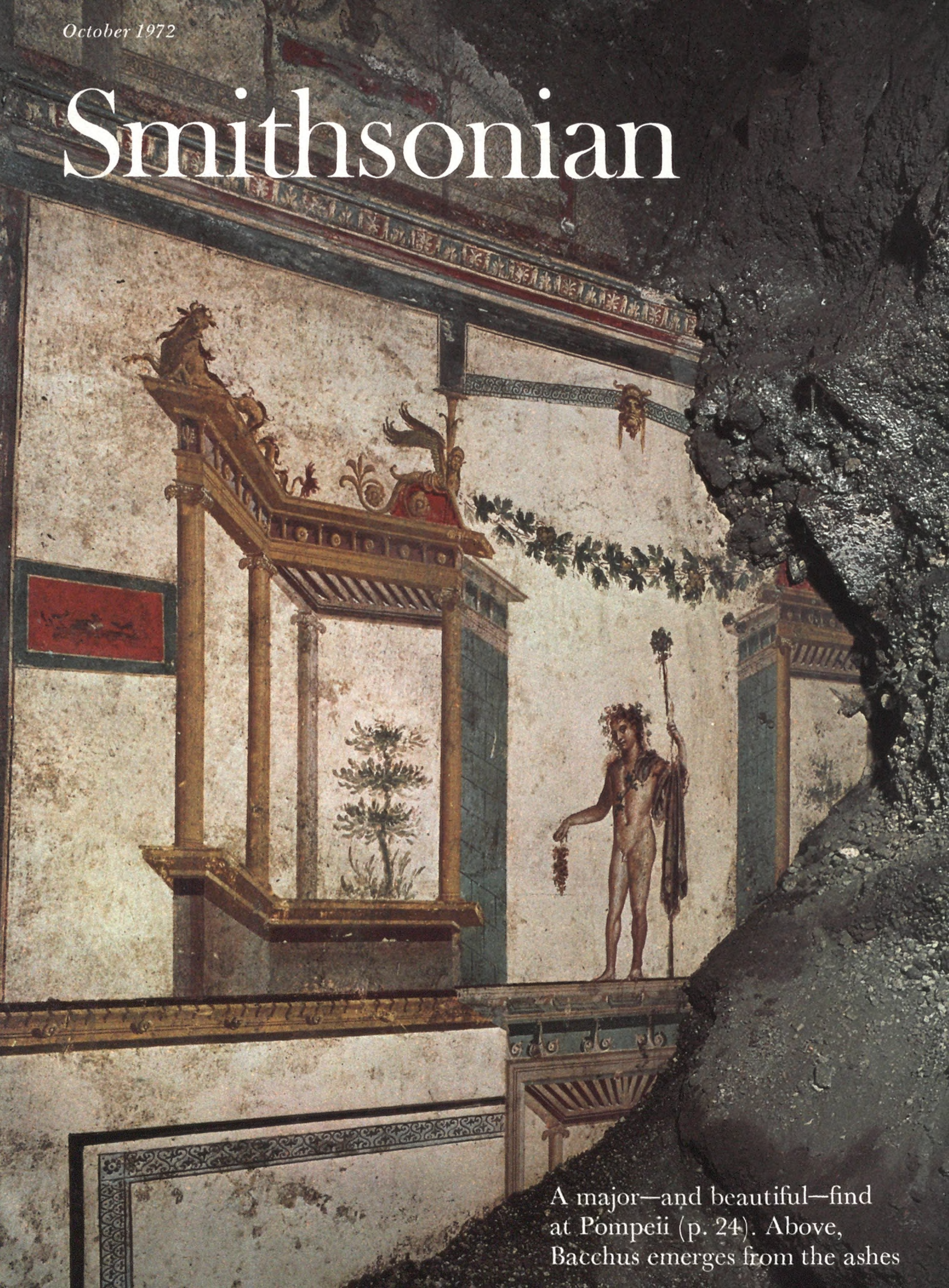
October 1972

Smithsonian



A major—and beautiful—find at Pompeii (p. 24). Above, Bacchus emerges from the ashes

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To begin with, there's the 1973 Imperial's comfortable ride, so quiet it's almost eerie. It's the result of a unique combination of its torsion-bar suspension (for good handling) and a sound isolation system that's designed to give you an extraordinary sense of remoteness and serenity.

We've added new sound deadeners to the '73 Imperial. Strategically placed foam seals, silencer pads and vibration absorbers, to name a few.

The interior of the new Imperial is enough to make you wish you didn't have to leave it. Depending on the model you pick, it indulges you with beautiful Cologne leather seats, individual folding center armrests, rear-seat reading lamps and built-in foam pillows.

To comfort your mind, our Electronic Ignition System starts up the car's insides no matter how wet the weather gets outside.

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The idea never.

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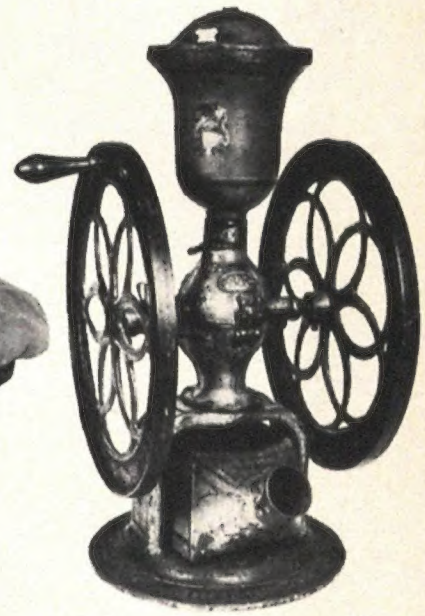
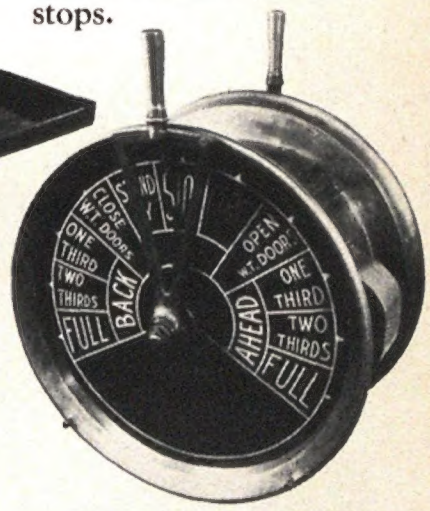
Sweep into pioneer country and shop for mountain crafts in Virginia's majestic Southwest. Explore Roanoke. Then drive through the Shenandoah Valley to Staunton and its stately Manse, where the 28th President of the United States was born.**Woodrow Wilson slept here.**

A front-row seat to history is yours at Alexandria's Carlyle House where George Washington began his military career. And you'll find the George C. Marshall Research Library in Lexington a living biography of a great general and a moving **picture of an elder statesman.**

Hats off to the General at Norfolk's MacArthur Memorial, where Walter Cronkite narrates the life of America's most decorated officer. Or cross the state to Blacksburg's Smithfield Plantation. From Indian days to the age of the gentleman's dressing table, it's a fascinating **reflection of a growing nation.**



The turn of the century was a fascinating potpourri of coffee grinders and gramophones, corsets and bellows. See it all through Grandma's eyes at Stoner's Store in Fredericksburg. And if you love the sea, don't miss Newport News and the Mariners Museum, where you'll find everything from figureheads to ancient maps. In Virginia the **wheel of history never stops.**



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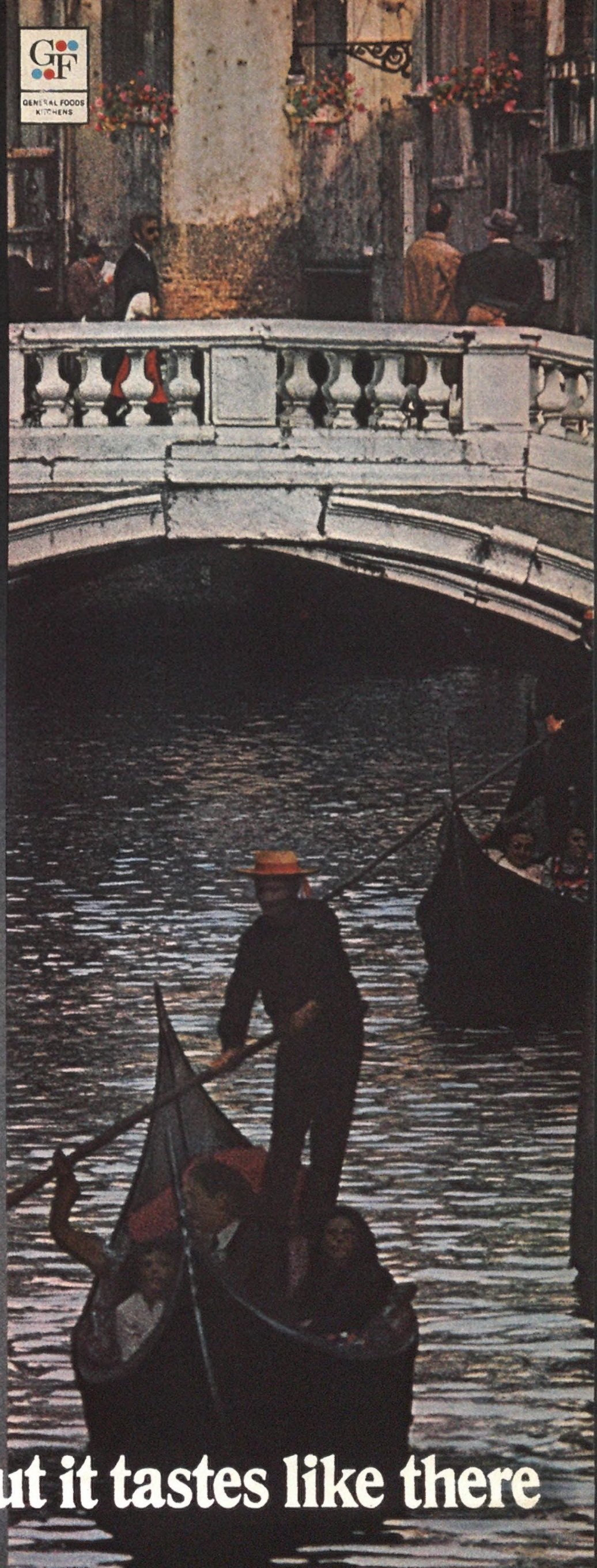
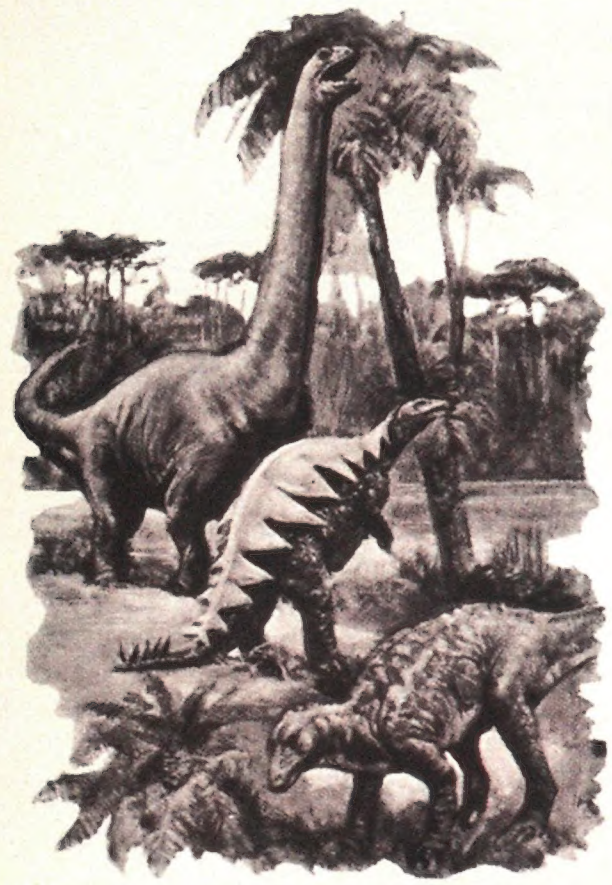


We make it here but it tastes like there

It is two million years ago. On an African savanna, a strange creature browses for food. He looks something like an ape and also like a man. He walks upright — yet his forehead is flat, his jaw thrusts forward. He doesn't know it — but he represents a giant step forward in evolution. For he is the "missing link" between ape and man . . .



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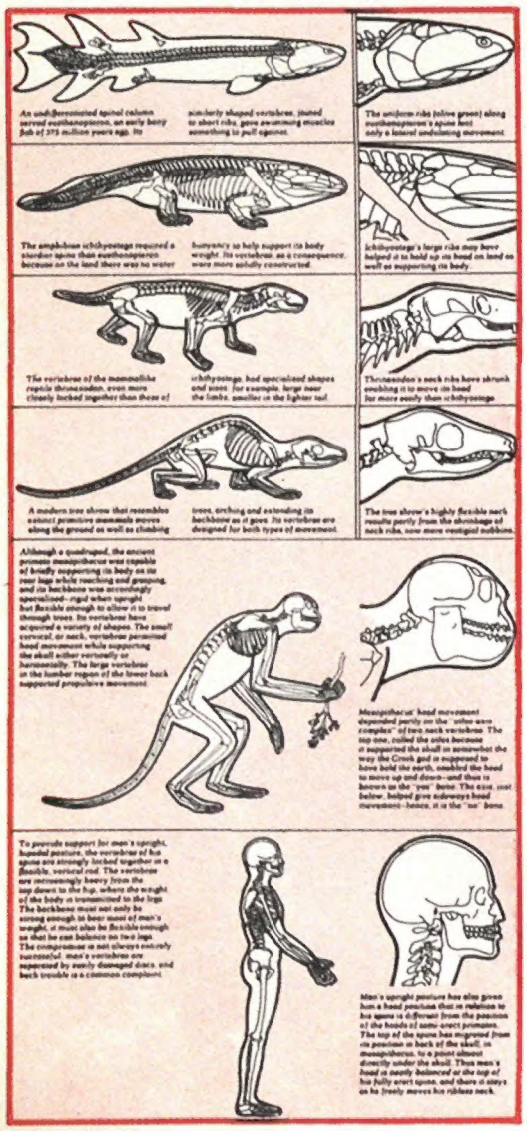

Color-keyed charts like this make the evolutionary processes easy to understand.

Today, that creature who first ventured to raise himself above the other animals no longer exists; he has become you. Unique. Set apart from the 2 million other species living on the planet by a thumb that makes your hand a precision tool . . . by a knee that "locks" you in a comfortable upright position . . . and by your capacity for abstract thought and speech. All this, and more, has enabled your species to dominate the earth. And yet you share, with every other creature that ever lived, the same origins — the same accident that led to the spontaneous creation of the first single-celled algae 3.5 billion years ago.

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Do you know:

- why you get goose-pimples?
- why you have traces of webs between your fingers, the remnants of a second eyelid in the corner of your eye and a useless appendix?
- why the human fetus has gills?
- why some people are able to wiggle their ears?
- in what way Neanderthal Man was "religious"?
- where and when wine-drinking began?
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- if any creatures except man use tools?
- whether or not there are still Neanderthals among us?

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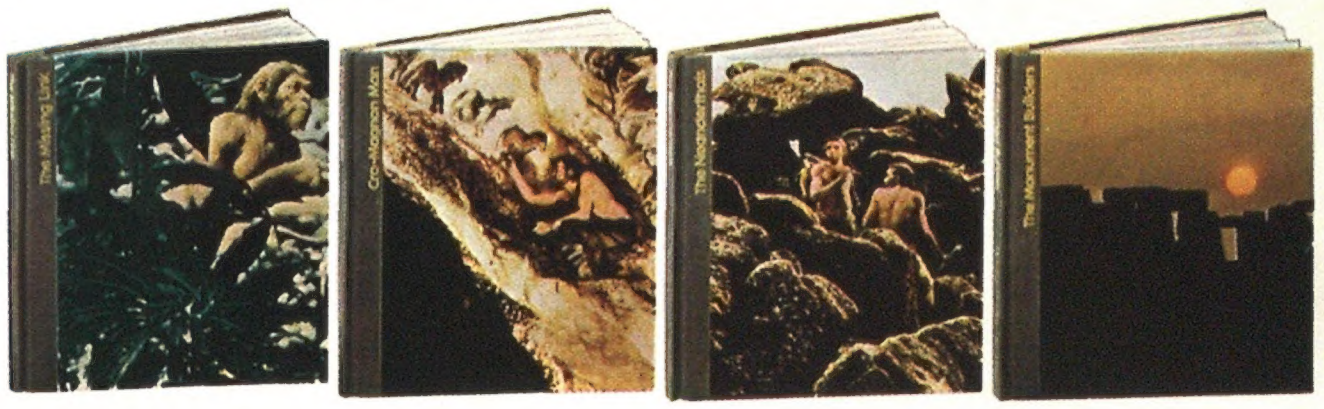

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Secretary Ripley's comments

The view from the castle

The more we learn of whales, the more
they seem like the ocean's 'people,'
but they are still managed like a crop

Even before the birth of the Republic, the sea served as a hunting ground for American whalers. Most Americans have grown up with romantic stories, like Melville's *Moby Dick,* of the 19th-century whalers who sailed from New England ports searching the world oceans for the mighty whale.

After a long decline, commercial whaling by the United States had virtually disappeared in recent years and was finally banned in 1971. Paralleling the decline of American whaling is the rising popular interest in whales as rare and fascinating animals.

Although dolphins and porpoises have been thought of as friends to mankind since classical times, the sentiment and emotion aroused by whales in general have reached a crescendo only in the last ten years. The recent experiments of Dr. Roger Payne and others in producing evidence of extraordinary intelligence among the cetaceans, as well as speculation about their high degree of social coordination, have promoted growing popular interest. Whales are now thought of in the United States as being closer in intelligence to humans than almost any other animal.

On the other hand, the International Whaling Commission was founded in the 1940s to establish quotas for the international whaling industry—an attempt at scientifically organized "management." The Commission was set up to manage a crop, and a crop it is still considered to be. But the call for a moratorium on whaling by the Stockholm conference and U.S. action in banning the import of all products from the eight species of great whales have served notice that a new wind is blowing.

Last June, for the first time in its history, the Commission agreed to a number of points which indicate that protection of marine mammals for their own sake may eventually come to play a new part in its deliberations. The Commission's greatly increased annual budget, if approved, would enable it to employ a full-time secretariat and to serve as coordinator for expanded research.

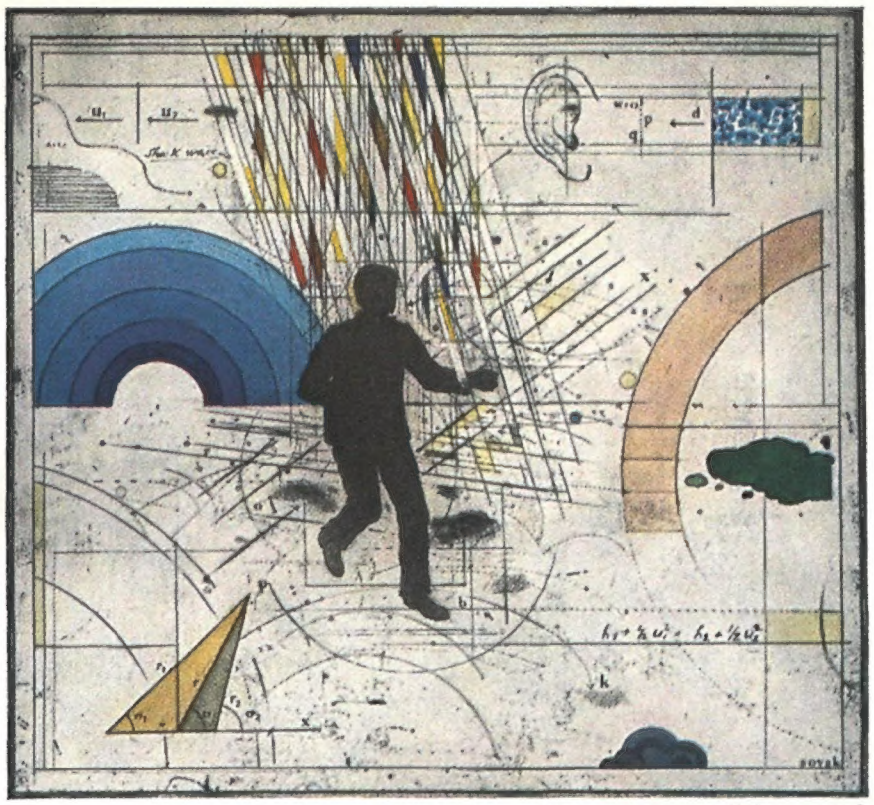
The Commission also agreed to take an interest in the smaller members of the whale family not presently considered an economic resource. Each year considerable numbers of dolphins and porpoises, for example, are trapped and drowned in tuna nets.

Our understanding of the sea depends greatly on our understanding of the ecology and behavior of the large marine mammals. They are all part of a complex, interwoven web of life. As the resources of the sea continue to be depleted and as these great mammals continue to be hunted for commerce we are losing an opportunity, through lack of sponsored research, to understand their role in the marine ecosystem as well as their role in life itself.

Slowly but surely human sentiment is turning towards a live-and-let-live attitude about our fellow animals, despite the refusal to cooperate by Japan, the USSR and others.

It is likely that the voices from the deep will continue to sound for many years before research on their social behavior tells us what whales are thinking about and how they feel about the rest of creation. Let us hope that we can continue to inform ourselves about these fellow inhabitants and learn to understand the tones and meaning of all the voices that are raised on the surface of our planet.

S. Dillon Ripley



artist: p. sovak

The real

Technology has trapped us in a roar of unnatural sound which threatens our health, our thinking —our very sense of well-being.

The ideal

We can rediscover our own best natures when we once again find the quiet that has been lost.

Total environmental noise is doubling every ten years. And unwanted sound forces up our blood pressure, tenses our muscles, frazzles our nerves.

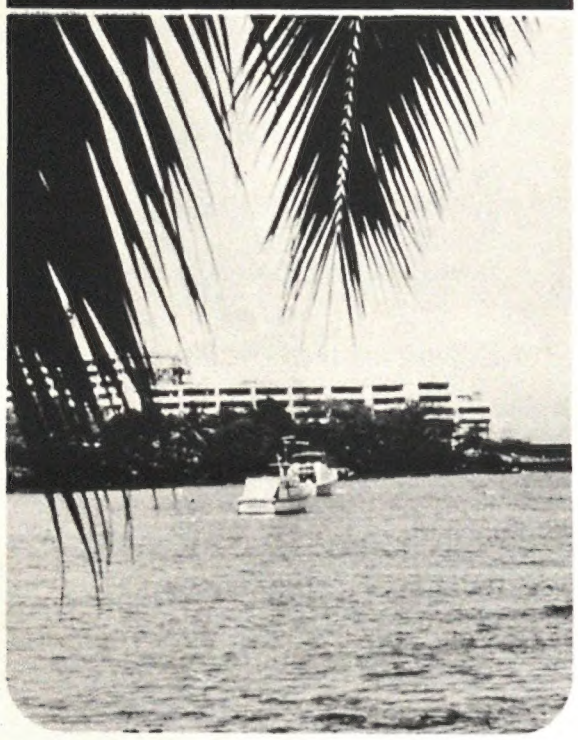
But noise is an environmental enemy we can conquer with better urban planning, improved industrial design, well-planned legislation, sound-dampening construction, and above all, respect for one another's right to quiet.

It's time for all of us to help plan ways for quieting things down—while we can still hear ourselves think.

AtlanticRichfieldCompany

artist: seurat The Art Institute of Chicago

Letters to the Editor



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Fantastic animals

Dear Sir: How could Gerald Carson in his article in the August issue on America's fantastic animals have overlooked the fabulous Cascade borkle of the Wyoming Rockies?

Almost two decades ago in an article in *Outdoor America,* Robert C. Burkholder wrote that the borkle *(Onots Louisiana)* had ears minus one inch long, a tail that varied in length from 3/16ths of an inch to three feet, and only three legs of equal distance from body to ground. The creatures weighed 904 pounds, plus or minus 401, and were gray with black spots that floated from left to right. Since the author and his assistants were color-blind, further study of coloring might be required. He reported the mating season as January 15 to January 16, and the average litter of young borkles as numbering 34⅓. Borkle eggs were considered a delicacy.

William Voigt jr.
Mechanicsburg, Pennsylvania

Dear Sir: Although John James Audubon may have been playing games when he described the Devil-Jack Diamond-Fish, isn't it conceivable that such a fish could be the gar? It can grow to ten feet, can weigh more than 300 pounds, and its diamond-shaped scales are thick and hard. On occasion, American Indians even used the scales for arrowheads. Even today gar scales are painted and made into ornamental jewelry.

George W. Summers
Marquette, Michigan

Dear Sir: My father, whose boyhood was spent exploring the wild regions around Denver, c. 1895, often told me of the

A mistake in identification

In the September SMITHSONIAN article on the Jersey Wildlife Preservation Trust, the picture at lower right on page 27 did not, as stated, show Rothschild mynahs (above). The birds were a blue-and-yellow and a scarlet macaw. SMITHSONIAN values accuracy and habitually checks statements with experts in the fields involved, particularly in the natural (and other) sciences. This error resulted from misreading numbers on the pictures, correctly captioned by the photographer, and a rare failure to show the macaw pictures to an ornithologist. We apologize to readers we may have misled and, of course, to Gerald Durrell. *Ed.*

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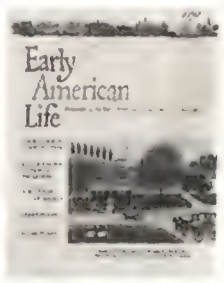

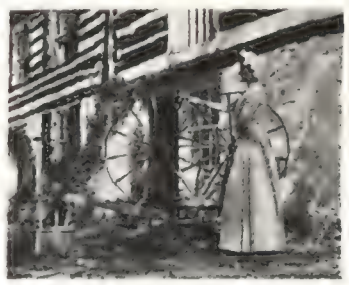

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curious animal you called the sidehill gouger (he knew it as the sidehill swoper). The clockwise and counterclockwise animals were of opposite sexes and the "terrible fight" you described was their mating ritual. The animals might be captured by driving them to level ground, where they could only run in circles.
Anne Townley Graney
Chevy Chase, Maryland

Dear Sir: Your article reminded me of a mythical monster once alleged to have roamed the Connecticut woods. It was the Glastonbury Glawackus.

The Hartford Courant

A church deacon, undoubtedly on his way home from a choir meeting, was one of the few people to have seen the beast, described as slinky, catlike with a long, bushy tail. Some thought it looked more like a dog, and others, a combination of cat and dog. It was supposed to emit raucous screams and prey on domestic animals—one suspected victim was a goat.
Mary Blain
East Hartford, Connecticut

Dear Sir: Since Mr. Carson reasonably used sources he believed to be "either reliable or unreliable or somewhat doubtful," his research was incomplete. Foresters in Missouri who are devotees of the Karkaghne *(Karkaghne Ozarkensis)* are just as unreliable as anyone.

The taxonomic description of the beast was first written by Ed Wood and Gus Hoyer after a hair-raising experience 30 years ago. It is blind, covered with fur feathers and shell, and its tail possesses all the sensory organs. For this reason it flies backward to feel where it is going. Its

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only food is limestone. The Karkaghne usually bears its young 40 miles from land, sea and air, but it does occasionally lay eggs in the earth. When the eggs hatch, the little critters eat so much that sinkholes form.

It is a bane to foresters and surveyors since it eats section corners, which in these hills are made of a pile of rocks and a pine knot. Its voraciousness has led to caves throughout the Ozarks.

In the tribal memory of the Osage Indians, five warriors set out to capture one. The beast flew clear across Kansas and Nebraska and like to starved before it found food in the Black Hills at Wind Cave. It found enough limestone to sustain itself at Oregon Caves, but it finally ate its fill at Carlsbad, New Mexico.

Artist Ward Degler once surprised a Karkaghne and barely escaped the beast's wrath by swimming six miles up the Current River. Infuriated, it pursued him but flew so fast that it couldn't negotiate the bends in the river, and flew into the side of a bluff at Round Springs Cave and didn't come up for air until it came out of Cardareva Mountain.

In memory of this experience, Degler painted the scene above.
John E. Wylie
Missouri Department of Conservation
Jefferson City, Missouri

Dear Sir: I regret Mr. Carson didn't include some of the fantastic animals that

once frequented the Chesapeake Bay area.

The Maryland sidehill murk was very similar to the Arkansas sidehill gouger, but less bloodthirsty. It spent its time looking for four-leaf clovers. The right- and left-handed ones used altitude separation to avoid collisions. The practice was later adopted for our airways.

George van Deurs, Rear Admiral (retired)
Belvedere, California

Dear Sir: We feel that some emendation will make the Carson article more useful.

The taxonomy of the sidehill gouger *(Membriinequales declivitatis)* is more complicated than Carson suspects. There are subspecies, not yet formally named but recognized by local inhabitants, and there is more than a scintilla of evidence that the morphology and habits of these taxa can be correlated. Among many examples, we can cite the sidehill dodger, which inhabits the Driftless Area of Wisconsin; the dextrosinistral limb ratio approaches unity although the metapodials on the downhill side are noticeably stouter. The sidehill gouger is the common Pennsylvania species, but it has been speculated (Hotton, *in litt.,* 1972) that all of the different varieties spring from the little-known strike-runner *(Crestophilus ambiguus)* in which the right front and the left rear limbs are short and the left front and right rear are long, or vice versa. These animals ran the long Tennessee ridges in late Pliocene time but became extinct during the Pleistocene epoch, perhaps due to trauma resulting from attempts to run the ridges of newly formed glacial cirques.

Nicholas Hotton III
Frank C. Whitmore jr.
Silver Spring, Maryland

Short-lived phenomena

Dear Sir: Unusual Minnesota animal life extends far beyond the political variety (Humphrey, McCarthy, MacGregor, Mondale, among others) and the invasion by Canadian lynx you reported in short-lived phenomena.

The wolverine, fisher and moose are coming back in Minnesota, too. In the Twin Cities deer routinely ruin gardens, and black bears have become a nuisance in Duluth.

John E. Tilton
Chairman, Minnesota Zoological Board
St. Paul, Minnesota

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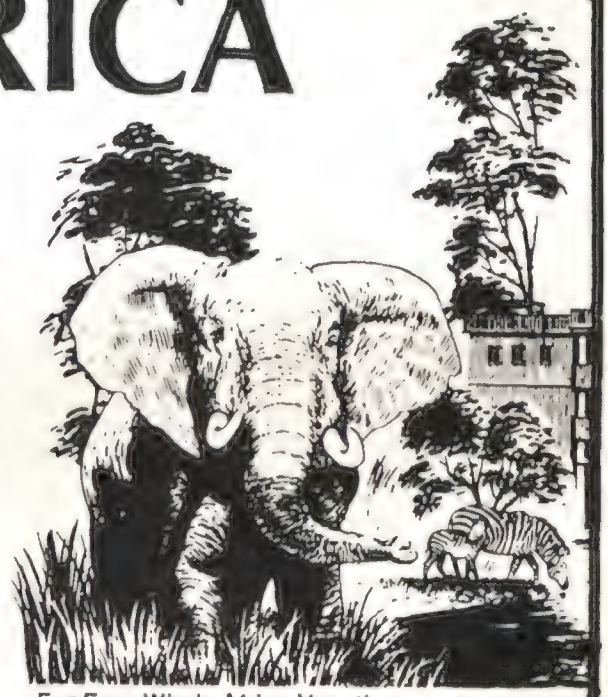

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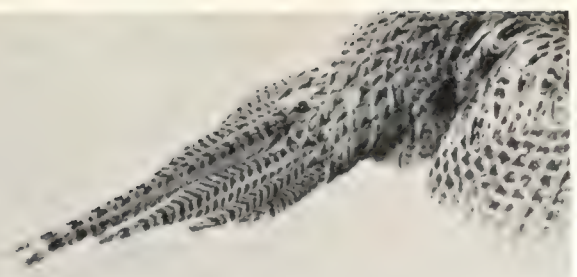

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Dear Sir: Mr. Gordon Hyatt, the self-proclaimed "sapsucker," belongs in the lower order of "nearsighted sapsucker" because the new species he thought he had discovered is an agave.
Helen F. Swanson
Melbourne Beach, Florida

Wilderness paintings

Dear Sir: As a national park tourist, I was amused to see the empty bottles in the left-hand corner of William Hahn's *Yosemite Valley from Glacier Point* in your article on the art exhibition commemorating the National Park System's 100th anniversary. On a recent trip to Glacier Point, I didn't notice any more debris than shown in this old painting.
Diane B. Steele
Anna, Maryland

'Early to bed . . .'

Dear Sir: Patrick Ryan's disapproval of the Puritan ethic in the July issue met with such universal commendation here that I sent it to a friend, Stuart McKelvey, Colonel, U.S.A. (retired) of Tiburon, California, who responded:

How I wish before I'm dead
I'll have a swinging water bed—
Swishy-swashy, yielding, sonic,
Maybe diced with gin and tonic. . . .

Reassured I'll hoist a sail
And try it in a howling gale—
And tho I sink without a trace,
Magnificent that last embrace!

Robert N. Rogers
Salisbury, Maryland

Whales
Smithsonian Magazine

Dear Gentlemen,
I have been reading + studying about whales. I was surprised and sad to learn that the whales are becoming extinct because too many are being killed. They should be allowed to multiply, and then a certain no. can be killed. If Man continues to kill these whales, there will be none left when we grow up. Whales help to keep nature's balance in the sea. Whales are the largest creatures on earth. Let's protect them and let them live to roam the oceans.

Sincerely yours,
Rebecca McCabe

With Rebecca, 9, SMITHSONIAN *(September issue and p. 6 of this issue) also cares about whales.* Ed.

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Phenomena, comments and notes

Warming up the dinosaurs, murder by moonlight, an identity crisis for salmon and how to startle a turnip

It sounds unreasonable but what every vegetable farmer may need in his turnip patch is a jet airport (see p. 58). A team of physicists and biologists at the University of North Carolina at Greensboro subjected turnip seeds to loud noise—the equivalent of standing 100 feet from a 727 jet with its engines running. Wet turnip seeds thus treated germinated far earlier and far faster than either dry ones or those in a quiet environment. Just why this is so remains to be discovered.

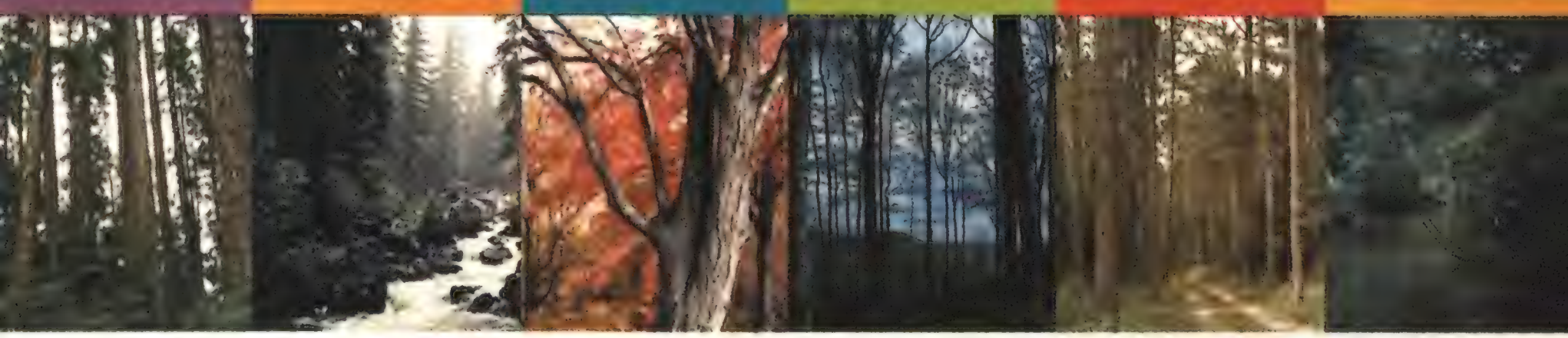
If this technique works for a variety of seeds, one can envision farmers getting two or more crops where only one now has time to grow. It has even been suggested that weeds could be fooled into growing quickly before the fields are planted, and then plowed under. But a few major questions are yet to be resolved: For example, do noise-treated turnip seeds produce normal plants? In fact, would noise-treated farms produce normal farmers?

Nuclear power status

About three-and-a-half percent of the nation's electricity is generated by 29 nuclear power plants operating in 14 states, according to the Atomic Industrial Forum. An additional 111 plants are under construction or on order.

On the other hand, for a period of 14 months ending last May not a single newly constructed nuclear power plant re-

The great American forest is closer than you think.



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Even more surprising, this 761 *million* acres is still widely distributed all across the country—it's not all just "out West" or "down South." 51% of New York State is forest. 65% of Rhode Island. And 51% of New Jersey—the most densely populated state. As a matter of fact, more than half of the forest in the continental United States is located in the eastern part of the country.

Because America's forest is truly an *American* forest, growing in many different elevations and rainfalls and temperatures and soils, its six distinct natural regions provide us with a constant variety, too, from the Douglas firs of the Northwest to the hardwoods of the Northeast.

Much of the forest has been harvested and regrown three or four times. And, public or private, government or individually owned, much of it is available for hunting and fishing, picnicking and camping—as millions of outdoorsmen from Maine to California can tell you. So if you haven't seen it lately, why wait?

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Baroque Tour: Baroque architecture in Germany, Austria and Switzerland; plus medieval tours and visits to private and public art collections—May 13-June 4, 1973.

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Sites of Civilization: Three-week cruise from Athens to Rome (depart from and return to New York by air)—October 6-28, 1973 (waiting list only).

ceived a full operating license from the Atomic Energy Commission.

The reason, complains the industry, is the National Environmental Policy Act of 1969 which calls for environmental impact statements on major federal projects and has led to a lengthening review period by the AEC. Others say that old-fashioned construction delays have been the main problem. In any event, more delays are likely. Environmentalists are pressing their attacks on the AEC's safety standards (a subject so complex that in September a little publicized AEC hearing on reactor safety had been under way for eight months).

Yet if the nuclear industry is to meet the expectations held for it—that 24 percent of the nation's electricity be generated by nuclear plants by the end of 1980—those 111 plants plus about 20 more will have to be on line in eight years. The lead time for nuclear plant construction alone is seven to nine years.

The blood of the dinosaur

Warm-bloodedness gives us mammals (as well as birds) the capacity to regulate our own body heat. Reptiles, fish and other cold-blooded animals assume the temperature of their surroundings. Now evidence is accumulating that, unlike other reptiles, the dinosaurs became warm-blooded and this may have had something to do with their particular success *and* their disappearance 65 million years ago.

Robert T. Bakker of Harvard has summarized the case for warm-bloodedness in *Nature* and it is a matter of energy, size and feeding requirements.

First, a cold-blooded animal is capable of less energy output and therefore less speed than a warm-blooded one. But fossil footprints and dinosaur anatomy indicate an erect speedy gait; a few may have raced through Cretaceous landscapes at the speed of an ostrich, an alarming idea considering their size.

In fact, there were no small dinosaurs, though there were other small reptiles around at the time. And large size fits well with a warm-blooded, naked-skinned animal (consider the elephant): Heat loss is less, proportionately, for a larger animal than a smaller one. If you think about it, there are very few small warm-blooded animals that don't have fur or feathers. So, it seems, warm-bloodedness permitted the dinosaurs not only great

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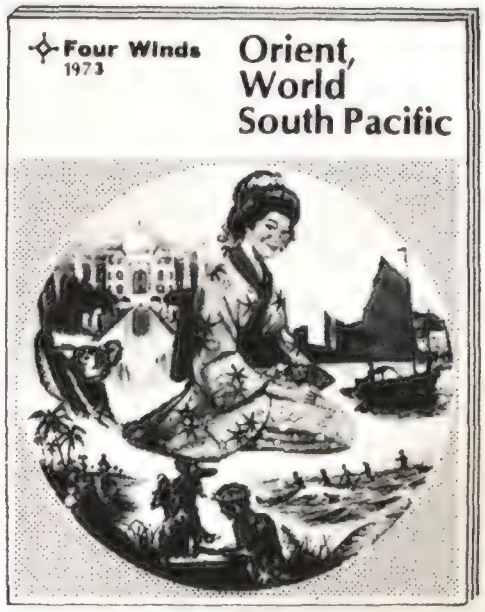

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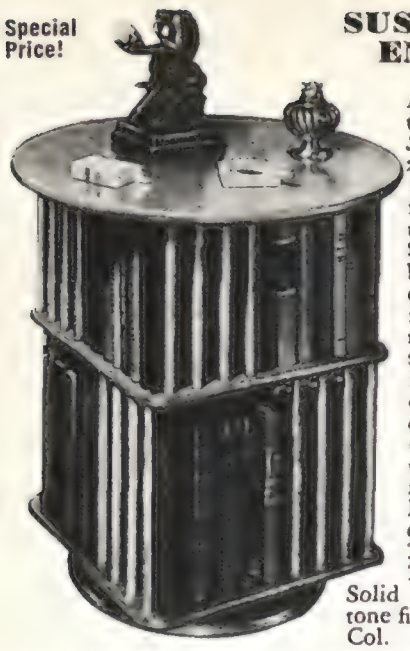

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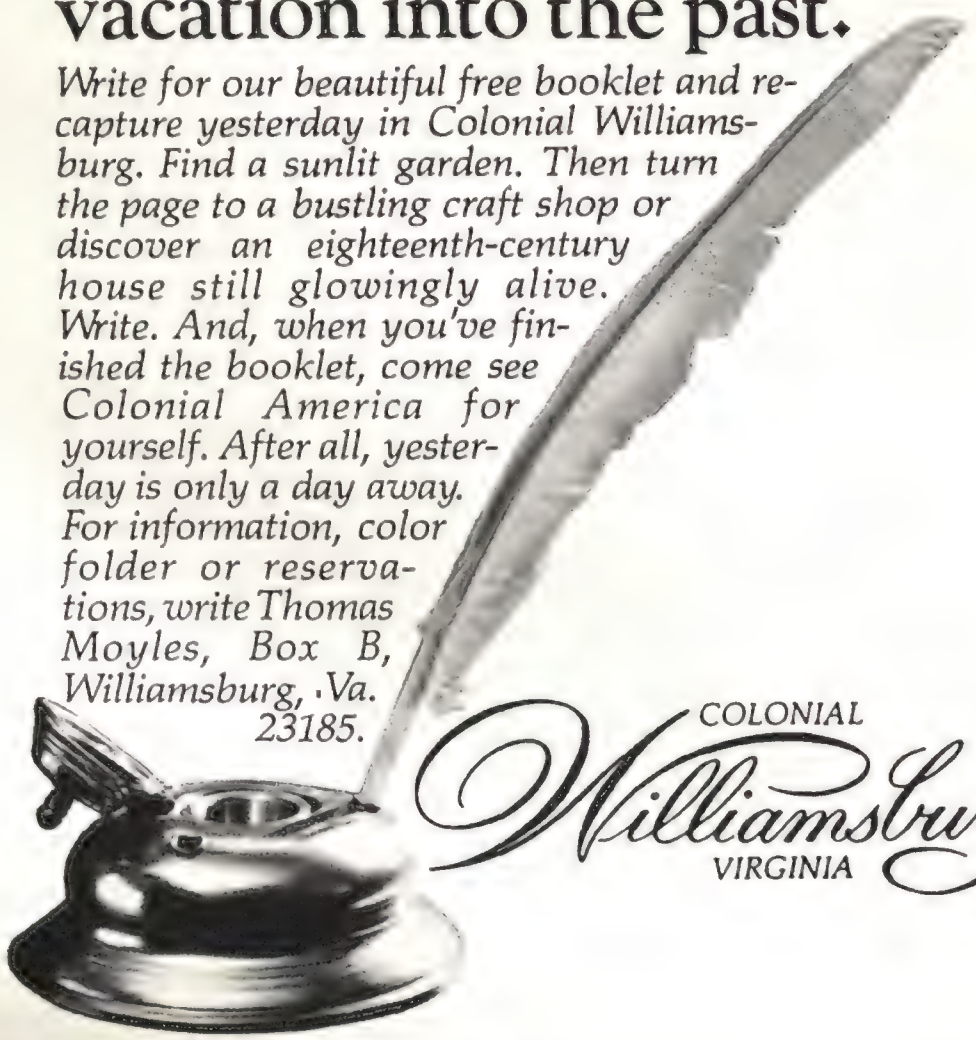

COLONIAL Williamsburg VIRGINIA

speed but allowed for their great size, too.

Finally, according to Bakker, it is known that a warm-blooded carnivore must eat more than a cold-blooded one, which means that in normal circumstances it needs a larger number of prey animals in its community. And while fossil evidence is sketchy here, it appears that carnivorous dinosaurs (as contrasted

Ceratosaurus' blood may have run warm

with those that were herbivorous) were appropriately few in number compared to their available prey.

But as Sam the Gonoph said in another connection, the odds are always 6 to 5 against. Rather abruptly the world's temperature dropped and the naked, energetic, warm-blooded dinosaurs—by now far too large to burrow underground like their smaller, cold-blooded reptilian relatives—may have radiated away too much body heat in the cold and died out.

While this extinction theory remains hypothetical, there is some fossil evidence that points to yet another cause. German scientists have found, in France and Spain, that toward the end of their reign the dinosaurs were producing eggs with ever thinner shells, ultimately too thin to support the growing embryo. Perhaps, in these locales at least, it was a case of overcrowding that led to hormonal changes. In either case, one gets the feeling that it was, partly at least, too much success that spoiled the dinosaurs' chances.

Ancient lunar troubles revived

The moon waxes full and howls pierce the night. A man who is normally a good citizen grows hairy and a werewolf runs amok in the neighborhood. Such is one of the ways people have long assumed the moon to affect human life. Now two researchers from the University of Miami's School of Medicine have studied the data

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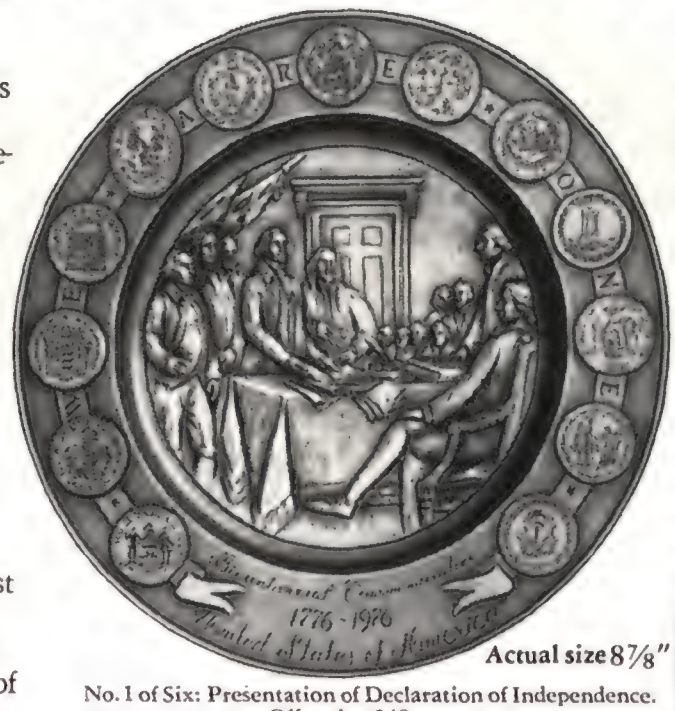

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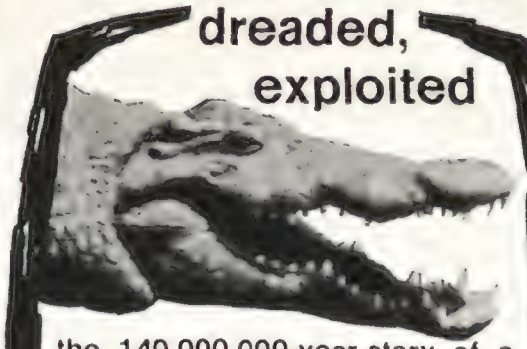

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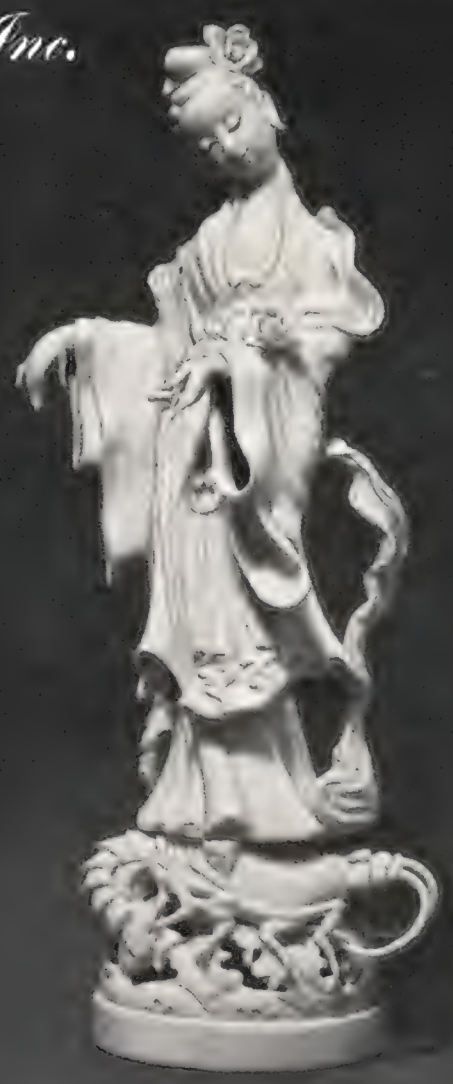

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from police records in Dade County, Florida, and Cuyahoga County, Ohio. In Florida, the homicides were at their most frequent when the moon was full or just after a new moon.

In Ohio, the results were less conclusive but, undiscouraged, the researchers leaped eagerly at a new version of Man's ancient myth. The human body is mostly water, they say, and the moon's gravitational pull might cause some crucial changes in the body's overall water flow as well as in its more intimate fluid compartments. Before getting out the silver bullets, one would hope for a little further research into the idea of biological tides, and one question might be how they make the werewolf's hair grow.

The salmon's identity crisis

With people building dams and pouring foul substances into their streams and rivers, the arduous life of the salmon has been made all the more difficult. British scientists have now identified yet another problem for the salmon—a far more subtle blow delivered (at least in some British streams) by the salmon's close relative, the trout.

Analyzing the blood of some 4,000 fish that looked and acted for all the world like salmon, the biologists found that 17 percent were hybrids of salmon and trout. (Such hybrids have been artificially produced for some time in British hatcheries but rarely are found in the wild, and natural hybrids had not previously been looked for.) Quite aside from the problem to food packagers diligently trying to obey labeling laws, it could become a serious matter, especially in streams with large trout populations and dwindling salmon. In such cases, fertilization of salmon eggs by male trout unfastidiously patrolling the redds could contribute to the pure salmon's extinction.

Stardust

Romantics will be delighted to hear that there is such a thing as stardust. Three scientists have reported in *Nature* that rockets sent aloft into noctilucent clouds over Sweden have detected particles which, they conclude, very likely come from the sun, our nearest star. What is stardust made of? Such heavy elements as rubidium, ytterbium, osmium and (appropriately) tantalum.

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Photographs by Dmitri Kessel

Spectacular new finds made in inexhaustible Pompeii

After 200 years of excavation, the buried city can still yield such surprises as these remarkably well-preserved frescoes

Until recently, C. Julius Polybius was one among hundreds of names found scrawled upon the walls of the ancient Roman city of Pompeii. In one of these graffiti, three bar girls had urged his election for a high administrative office, more or less akin to that of a modern mayor, and implishly signed it "Aegle, Maria and Zymrina."

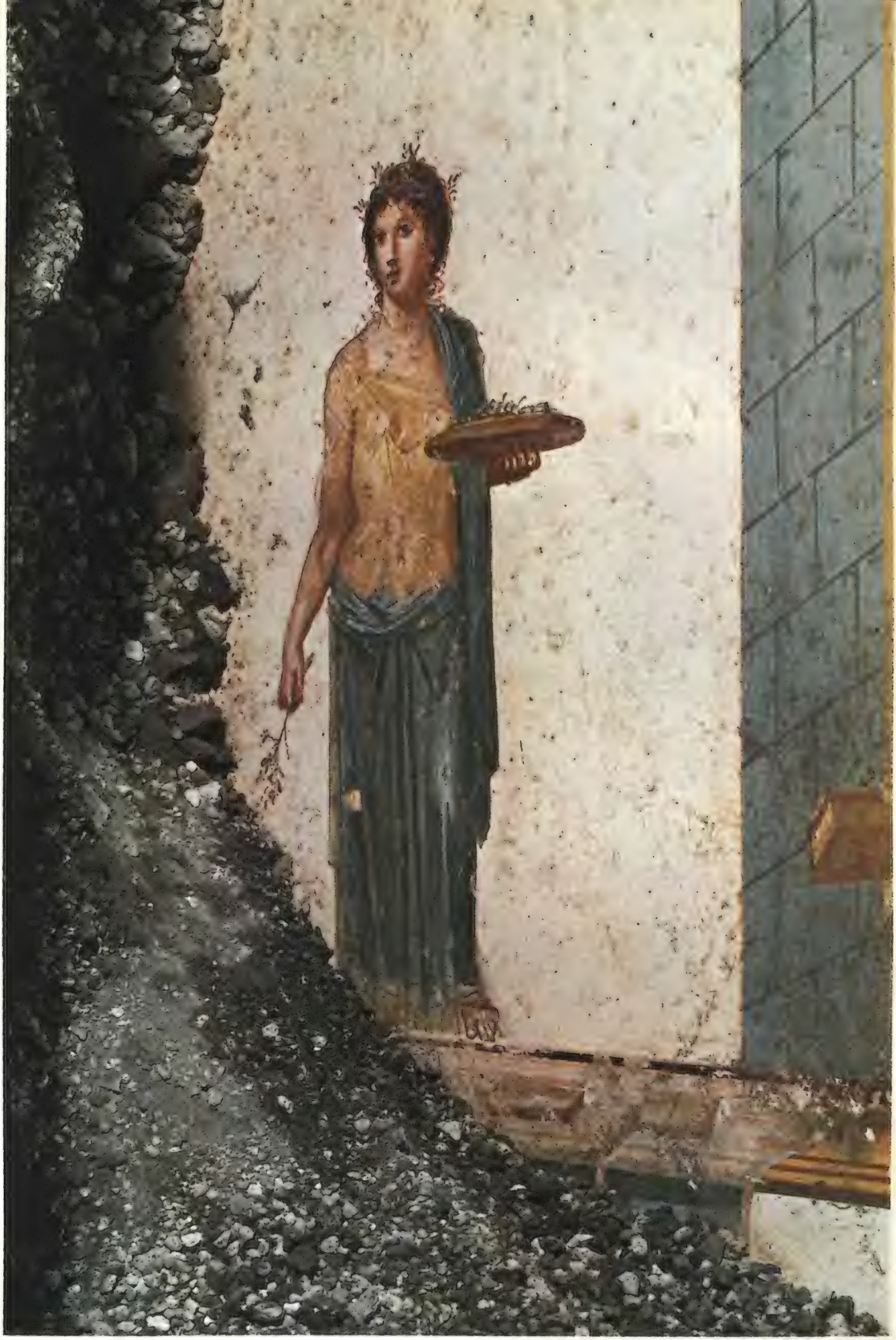
Polybius, like perhaps 20,000 other Pompeiians, was never heard from after that catastrophic day in A.D. 79 when Vesuvius spewed a rain of ashes and a hail of pumice stones into the city. The people who sought shelter indoors quickly suffocated in clouds of poisonous fumes.

Although Pompeii's destruction was recorded by ancient historians (most notably by Pliny the Younger), few believed that any trace existed. Then in the mid-18th century a series of accidental finds and a few treasure-hunting digs established that Pompeii did indeed exist. Since then, excavations have been under way almost continuously.

The existence of the house shown on these pages had been known since 1925. But only in the last five years have archaeologists found the time (and the funds) carefully to sift their way, aided by the relative lightness of the ashes, through part of the building. They have discovered that the house, which is wonderfully preserved, was the home of Polybius.

On the following pages, Professor Alfonso de Franciscis, the Superintendent of Pompeii Antiquities, explains the significance of the discoveries.

An excavator scrapes away loose ash in front of a painting of Bacchus (see cover) in Pompeii's final style, with typical architectural fantasies. Opposite: a bacchante from same area off peristyle.



The main atrium includes false door, second-story windows and pile of materials for remodeling.

By Alfonso de Franciscis

When it is fully excavated, the house of C. Julius Polybius will undoubtedly stand forth as one of the most noble and interesting dwellings of Pompeii.

The man who lived there at the time of the fatal eruption of A.D. 79 must have come from a family of freemen of the *gens* Julia, as we may deduce from the name. Several inscriptions on this house and on buildings in other parts of the city show that he came from a middle-class family which had achieved some economic success.

He was the proprietor of a posthouse where tourists and commercial travelers could find some degree of comfort, take their meals and obtain horses or carriages to continue their journey.

Polybius' house on the Via dell'Abbondanza, so named by archaeologists for its prosperous dwellings.

The large dwelling on the Via dell'Abbondanza ("the street of abundance," as archaeologists call it, because it contained so many prosperous homes and shops) has a much earlier origin, however. Before Julius Polybius it belonged, certainly, to another Pompeiian family of ancient and noble birth. From what we can tell at the present stage of our research, the house dates back to at least the second century B.C. This is indicated by fragments of Campanian ceramics, and by the fact that some of the frescoes are in the earliest Pompeiian style, the so-called Style I, which flourished until the end of the second century B.C. Pompeii's wall paintings are customarily dated by their conformity to one of four period styles. Style II, which flourished until the middle of the first century A.D., features various architectural elements, shown in perspective. The overlapping Style III which began to appear around 30 B.C., is profusely ornamental with many Egyptian-type motifs. Style IV, which emerged around A.D. 50, is a revival of the second style, but is far more intricate and imaginative. Since Style IV was at the height of fashion in A.D. 79, it is the one most frequently seen in Pompeiian houses.

This fresco in the triclinium is a good example of Style IV decoration, which went in for bizarre architectural conceits and odd perspectives. The cornice is a palm-leaf motif cast in plaster.

A bird contemplates its next meal in one of the paintings decorating the peristyle walls.

A wading bird, also in the peristyle, somewhat skeptically inspects a pair of pomegranates.

[The accompanying photographs, showing frescoes in some of these styles, were taken in the main atrium which is entered from the street (page 26); the triclinium, a dining room (pages 27, 30, 31); the peristyle (pages 28, 29); the exedra, a sort of sitting room at the north end of the peristyle (cover, pages 24, 25); and the kitchen (pages 32, 33).]

The principal atrium, severe and formal, is in the earliest style. It is unusual in that it does not have a basin in the floor for catching rainwater, which leads us to believe that there was probably no opening in the roof. Above the decorations in this room is a row of windows which would have been on the second floor, rarely found intact in Pompeiian houses.

A false door leading nowhere

In these houses, also, there is usually a doorway from the atrium to the tablinum, a room for storing the family records, which were inscribed on tablets. But in the house of Julius Polybius there is no tablinum, at least not in this area, and instead of the usual opening a *trompe l'oeil* door (page 26) has been painted on the atrium wall. This door is designed and painted much in the same manner as the symbolic doors found in Etruscan tombs, and only further study can evaluate its significance in this setting.

The building was apparently badly damaged in the earthquake of A.D. 63, (which we, with a hindsight denied the Pompeiians, now recognize was a warning of things to come). As a result, the owner decided to make some radical renovations.

The walls of this atrium in the earliest style were partly dismantled and the renovation was in full swing when Vesuvius erupted. The walls were almost ready to be covered with the first coat of plaster, because one can see the holes in the wall where horizontal beams would have been inserted to support the scaffolding. They were removing the painted plaster frescoes of three centuries earlier. Apparently Julius Polybius thought these were old, worn and out of fashion; they were being replaced by new frescoes that imitated—though roughly and awkwardly—the ones being destroyed. The work was well along on the bottom part of the walls, but on the upper part, fortunately, the originals remain.

As testimony of the work in progress, however, we have a pile of *pozzolana* (a volcanic ash still used in Italy for making cement), waiting to be mixed with plaster, and a group of amphorae nearby which would have held the water necessary to make the mixture. Finally, we have a hinged wooden mold, standing near the door, of the type used to make the cast-plaster moldings familiar from other Pompeiian excavations.

It seems clear that in the first century A.D. the house

Continued on page 32

An eerie lineup of theatrical masks includes one (far right) of Silenus, oldest of the satyrs.

This charming rural landscape, painted with plenty of bravura, is only about seven inches high.

Venus and Mars face each other from opposite walls of the triclinium. While the god of war glowers

aggressively, the goddess of love—with the assistance of a cupid—checks her appearance in a hand mirror.

was enlarged, either by incorporating parts of adjoining houses or by adding on to the original building. Thus, beyond the first atrium we find a second. This one is more modest, almost rustic in comparison, but it is of the normal type with a *compluvium,* or opening for rainfall, in the roof; an *impluvium,* or catch basin in the floor; and small rooms all around.

One of these rooms, richly decorated on walls and ceiling in Style IV (pages 27, 30, 31), is a triclinium (dining room). Next to it there is a passage leading to a most intriguing complex. Here we find a little servants' courtyard and, beside it, a kitchen in which the hearth, the iron cooking tripod and the pots and pans of daily use still remain. There was a rare find here: the little hood over the hearth to collect the smoke.

Near the entrance to the kitchen is a wall bearing a large painting of the household gods (pages 32, 33), the *lares.* The two large figures at either side possibly represent the protecting deities, while the medium-size figures in the act of leaving offerings on the serpent-entwined altar may be Polybius and his wife. The two tiny figures are servants, painted small to indicate their inferior status. This is one of the finest paintings of its kind which have been found in Pompeii.

Also opening off the second atrium is the peristyle, an enclosed garden surrounded by columns, with a portico at the end. Several elements of Style I can still be seen in this area, but they have been largely replaced with newer decorations made in the first century A.D. The walls, once painted with rhythmic linear patterns, now show small still lifes and landscapes (pages 28, 29) in bright colors that must have harmonized beautifully with the plants and flowers of the garden. On the walls of the exedra, at the far end, are frescoes in Style IV showing Bacchus with a wreath of vine leaves in his hair (cover) and, opposite him, a bacchante (page 25).

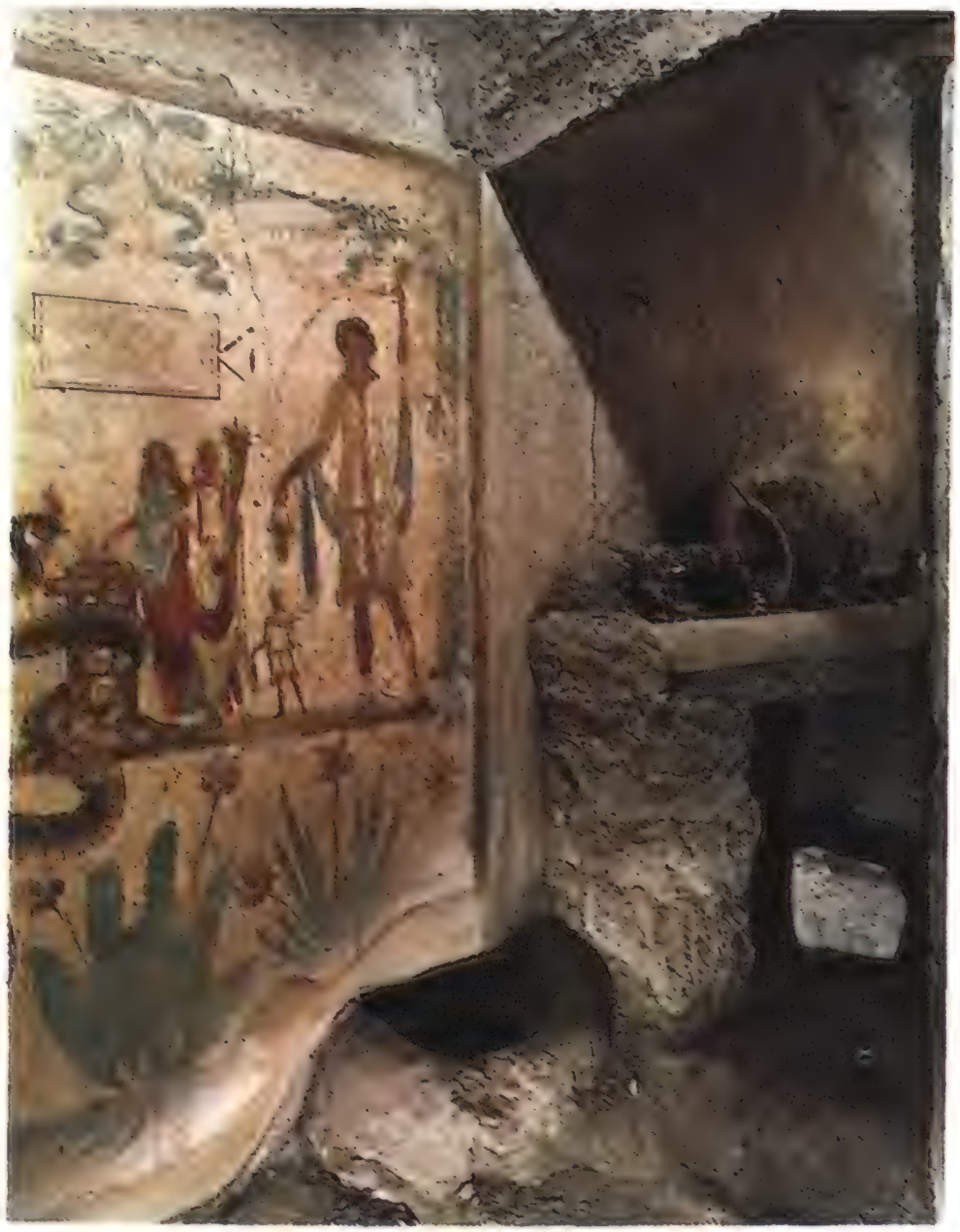
Someone came back, but who?

After the eruption, when the house was buried in ash and *lapilli* (volcanic fragments), someone tried to come back—possibly the inhabitants who wanted to save what they could, possibly casual thieves in search of valuables. One can still see in more than one place rough gashes in the walls, entrances for searchers in a hurry to get what they were after.

The excavation of the house of Julius Polybius is still in its first phase—as of now, we have seen only a small part of the house. Our methods require prudence and patience, but that is the only possible way to recover all the precious elements of the structure as well as the scientific data which are so often lost in excavations conducted with haste and lack of caution. This excavation will take a long time, and we do not exclude the possibility that it could extend to an entire section of the old town, as has happened before with some other Pompeiian houses.

So far, except for the frescoes, no object of notable value has been found. We have found many crude amphorae and some beautiful clay lamps. We know the reason for this: Sculptures and furniture of artistic value would have been in the reception rooms and other important rooms around the peristyle, and these have not yet been excavated. Also, judging by the state of the first atrium, they may have been taken away and deposited temporarily in some other place during the remodeling. It will take time to recover everything.

Still, we can already say that the Polybius house, with its singular and well-defined plan, with its extraordinarily well-preserved wall decorations from the earliest to the latest styles, represents a find in the same class with the most famous ones of our dead city.



The *lararium,* or family shrine, is next to the kitchen (at the bottom is a drain for waste water). In the fresco (opposite), the two figures at the snake-entwined altar may be the owner and his wife.

The author's canoe journey, traced in red, took him from spruce forests into true Arctic tundra.

At Wholdaia Lake he diverged from the route of the Tyrrells, who explored the Dubawnt in 1893.

Text and photographs by Peter Browning

Canadian canoe trip in a pocket of wilderness Man doesn't see

Rarely traveled even by Eskimos and Indians, the Barrens form a primordial environment for birds, caribou and swarms of rapacious bugs

North of the 60th parallel, east of Great Slave Lake and west of Hudson Bay is an immense sweep of land existing in a pure state (see map, opposite). Few have seen this least accessible region in North America, fewer have traversed it and no one now inhabits it. It has not been scarred by bulldozers, nor is there any hint of the furious activity that is bringing wealth and ruin to the North Slope of Alaska. It is simply land, carved and molded by glaciers: scoured boulders, ridges and low hills of white sand, the sparkling water of myriad lakes.

Recently another man and I traversed this wilderness by canoe, from spruce forests of the subarctic through the broad transition zone of alternate forests and tundra and on into the true Arctic region, north of the tree line. We started at Black Lake in northern Saskatchewan and traveled to Baker Lake, an Eskimo settlement at the head of Chesterfield Inlet off the northwest corner of Hudson Bay.

The first 150 miles of our journey were over an established Indian canoe route. White men first followed it in 1893, when two Canadians, the Tyrrell brothers, went with six Indians and half-breeds, starting at Edmonton and going from Black Lake to Wholdaia Lake and then down the Dubawnt River to Hudson Bay, exploring for the Canadian Geological Survey. In his account of the expedition, Joseph W. Tyrrell wrote: "Of almost this entire territory less was known than of the remotest districts of 'Darkest Africa,' and, with but few exceptions, its vast and dreary

Beached canoe and teapot set to boil mark a lunch stop on a stark and rock-strewn shore.

plains had never been trodden by the foot of man, save that of the dusky savage."

And the "dusky savage" seldom ventured into the Barrens area, for fear he would encounter his mortal enemy the Eskimo. An area of more than 200,000 square miles was so little known that the Tyrrells were not certain whether the Dubawnt River flowed to Hudson Bay or the Arctic Ocean. After the Tyrrells the territory remained essentially untraveled for more than another half century.

As we headed northeast toward a clear sunrise, we saw astern a plume of smoke from a fire that had approached to within a mile of Black Lake Indian Village. In this region, burned-over areas grow crimson fireweed the first summer after a fire. The fireweed soon gives way to blueberries, which in turn yield to various grasses and sedges. Then come birch and jack pine, supplanted by slower-growing but eventually dominant spruce. In several hundred years there will be a mature forest—which may well burn again.

My first emotion when going into the wilderness is always fear. All physical and psychological supports of our customary existence are missing. We are forced to rely on our own paltry resources, and we realize once again how unprepared we are for struggling against nature with only our bare hands.

But the fear soon passes. We feel that the wilderness will do us no harm. If we are careful, the waters will not open to swallow us, nor will some dreadful force fall on us out of the sky. We do not want to conquer nature, merely to exist in it for a while.

Among people who live close to nature the sense of long spans of time scarcely exists: What happened ten years ago may be referred to as though it were yesterday. Here time is circular rather than linear. There are night and day, changing seasons; a lifetime divided into childhood, prime and old age, rather than being counted, year by year, as is done in societies driven by clock and calendar. Here everything is born, lives, dies and is born anew.

Our first real taste of summer was a sultry, windless afternoon on Selwyn Lake. Small islands looked like clumps of stone trees planted in a sheet of polished glass. We paddled for hours toward an obscure horizon, seeming to get neither nearer to nor farther from any shore. We were suspended between an enormous empty sky and a watery bottom of unknown depth, condemned to paw feebly at the water with flat pieces of wood, having neither hope of success nor relief. We paddled on, each of us lost in his own fantasies. Twenty miles north of the 60th parallel we portaged a mile and a half across a barely perceptible height of land between Selwyn Lake and Flett Lake. We each made three carries to transport our canoe and 450 pounds of food and equipment. This was the last established portage trail. We were near the limits of the Black Lake Indians' winter travels; from now on we would have to pick our portage routes by map and compass. This portage was our equivalent of crossing the Continental Divide. The water in Selwyn Lake flows back the way we had come: to Black Lake, Lake Athabasca, Great Slave Lake and down the Mackenzie River to the Beaufort Sea. The water in Flett Lake flows down the Dubawnt and Thelon Rivers to Hudson Bay.

Perhaps the greatest single drawback to a northern summer is the ferocious insect life, although paradoxically it may be what has thus far spared the North

Author investigates an Indian cabin, last human sign for many weeks. A free-lance writer-photographer, Peter Browning relaxes by back-packing in the Sierras.

Musk-ox browses on the north bank of the Thelon. Some 10,000 still are in this game sanctuary.

from the inundation of progress. The insect season began in earnest in mid-June, and lasted for more than a month.

Mosquitoes are large and bloodthirsty, but gnatlike no-see-ums are worse. They always attack en masse, seemingly in a frenzied rage. Each bite leaves a red spot that itches for days. Insect repellent protected us from being bitten, but the no-see-ums would hit us before being repelled, and it was like being peppered by windblown sand. On the worst evenings we had to keep walking while we hastily ate dinner. Several times we were driven inside the tent.

On June 15 we crossed into Wholdaia Lake, 25 miles long and as much as ten miles wide. Its center is strewn with islands, and it abounds with bays and coves. It must have been a great puzzle to those who passed that way before it was mapped. Even for us it was often difficult to find the correct route when looking at a maze of islands from water level and comparing what we saw to a map scaled four miles to the inch. Many islands are almost perfectly round. These "kames" were built up by debris falling into depressions in the glaciers; when the glaciers melted, the debris was deposited as mounds or ridges.

Some of the lower islands—barely two or three feet above the water—never developed any growth and are nothing more than barren heaps of boulders. Gulls and terns use them as rookeries and would fly up with much screeching whenever we came too near.

Wholdaia Lake is a crossroads of sorts. Here the Tyrrells turned to the northeast and started down the Dubawnt. Here our route diverged from the ways of earlier travelers. We headed almost due north toward the headwaters of the Thelon.

Samuel Hearne, first European to reach the Arctic Ocean by land, traversed Wholdaia Lake on the ice in March of 1771 on his great journey from Fort Prince of Wales (present-day Churchill, Manitoba) to the Coppermine River. In two-and-a-half years Hearne walked close to 5,000 miles through some of the earth's least hospitable territory, accompanied only by Indians, often hostile and loath to lead farther. Some of the areas he explored are so remote and have such a harsh climate that they were not revisited by white men until this century.

The country has changed in but one respect since Hearne's day: It is now entirely uninhabited. Bands of nomadic Indians no longer exist there, nor have they left many traces—only occasionally a scattering of caribou bones and ashes of old fires could be found.

It is estimated that the present population of northern Indians is less than half of what it was 200 years ago. They have been decimated by smallpox, tuberculosis, diphtheria, alcoholism and starvation. Those remaining live in villages centered on the Hudson's Bay Company's trading posts. They work for wages—when possible—in summer, and in winter go into the bush to trap furs, but they no longer roam as far or as long as they once did. The only people in this land now are summer transients—canoeists such as ourselves.

If we had met anyone else we would have been not only surprised but annoyed as well. We grew accustomed to having the world to ourselves, and had no inclination to change the arrangement. Several times a day we saw jet airplanes passing over at high altitudes, probably flying between Europe and the West

Fox cubs line the lip of their den, curious and unafraid at their first sight of Man.

A large herd of barren grounds caribou
cross the Thelon on a mysterious migration.

Coast of the United States. They were only an abstraction. We could scarcely believe people inside them were members of our species. Yet the airplane can open up this wilderness.

With ever more people becoming increasingly affluent, these isolated lakes may someday resemble Lake Tahoe or Lake of the Woods or any one of a hundred other places with cottages lining the shore, powerboats fouling the air with fumes and noise, and the inevitable trashy commercialization. Most humans are incapable of reaching a wilderness, no matter how hard they try. They thrust before them a destructive shock wave of civilization, so that any place they attain, however remote and untrammeled, is spoiled by their presence —spoiled at the instant of their arrival.

During the Ice Age, streams flowed through and beneath the glaciers. As the glaciers withdrew, sand and gravel stream beds were left as eskers—long ridges, up to 200 feet high. Some eskers extend many miles, disappearing into lakes and rivers then cropping up again on the other side. We sought them out for overnight stops, as they invariably provided easy landings and good campsites with plenty of fuel. The porous soil of eskers grows larger trees, although fewer of them, than lower, flatter land.

At the north end of Damant Lake, near the 62nd parallel, we entered almost treeless terrain. On the morning of July 4 we left Damant Lake and started down the Elk River, a tributary of the Thelon. It would all be downhill for the rest of the trip. The Elk, typical of a northern river flowing over granite, is a series of lakes and ponds joined by narrow, rocky channels. It is a lovely river, but extremely arduous for canoeists, with one rapids after another, mostly too shallow and rock-filled to be run. So we would have to wade the canoe down, stumbling over slippery rocks in water to our knees, often taking an hour to travel a quarter of a mile. Several times the river narrowed into a gorge, and then we had to portage—the most tiring and time-consuming phase of all.

Even under the best conditions canoe travel here entails a great deal of hard work, and, when the

weather goes bad and the insects go crazy, one's misery is complete. But we were more than compensated by times of contentment and by the sense of isolation. We felt ourselves at home in all latitudes.

After the confluence of the Elk and the Thelon, the bedrock changed from granite to sandstone; through this softer rock the water cut a channel with a constant gradient and with few rapids. In 100 miles we came to the juncture of the Hanbury River, named after an English hunter, the first white man to explore the Thelon River system above Beverly Lake.

One morning, a few miles below the Hanbury confluence, we saw a herd of about 500 caribou. They moved at a steady trot, coming across the tundra from the northwest, swimming the river and continuing to the southeast. After 15 minutes the last caribou disappeared over a distant ridge, and the land was empty once more.

It may seem odd that caribou should be moving southward in midsummer, but the phenomenon has been observed by many people. One theory has it that the caribou go north in spring not only for good pasturage but to escape the height of the insect season in the southern part of their range. Then, after a storm has killed many of the insects and their breeding places have dried up, the caribou move southward to avoid the insect plague which is in full swing farther north. Mosquitoes, black flies, warble flies and nostril flies drive caribou into rapid migrations, or frenzied, aimless running—anything to gain release from the insect hordes.

For about the next 100 miles we moved through the Thelon oasis, a forested area along the river, well north of normal tree line. Some trees are 18 inches in diameter. The heaviest growth occurs at the base of low hills along the sides of the valley. Back from the river the trees diminish in size rather quickly, and soon disappear. Generally a short walk takes you past the timberline and onto the tundra.

Half a dozen times we saw musk-oxen on the left bank of the river, grazing in lush grass. We were in the heart of the Thelon Game Sanctuary, an area of about

15,000 square miles established in 1927 to protect Canada's remaining musk-oxen. There are probably fewer than 10,000, the survivors of an estimated half million that roamed an area of a million square miles as recently as 1800.

In the fall of 1926, John Hornby, an Englishman, who had spent more than 20 years wandering the uninhabited reaches of the North, took two young men to spend the winter with him on the Thelon River. They intended to shoot enough caribou during autumn's southward migration to last them until spring. But the caribou did not come that year. The men shot a few birds, trapped a few animals, suffered through the cold, dark winter and starved to death in the spring before the birds and animals returned. They are buried near the ruins of their cabin in the Thelon oasis north of the 64th parallel.

The last standing trees we found were about 30 miles above Beverly Lake, but there was plenty of driftwood and we had no trouble gathering enough for large fires. At the west end of Beverly Lake, huge quantities of wood had been cast up on the banks, some 15 feet above water level and as much as 100 feet inland—stranded there by high water during the spring breakup. A big fire that evening was welcome. Summer was already on the wane: The days were shorter, the nights colder. We found that we could no longer muster as much body heat as was necessary, perhaps because we weren't getting enough food. We had lost the protective layer of fat over our ribs, and we became chilled easily.

The Dubawnt River, route of the Tyrrells, enters Beverly Lake from the south. Beyond that point there was no more driftwood, and we cooked on a gasoline camp stove.

Small groups of Eskimos still lived "on the land" as far inland as Beverly Lake in the early 1950s. But a scarcity of caribou, coupled with encouragement and pressure from the government, has had the effect of concentrating the Eskimos of this region at Baker Lake and several settlements on Hudson Bay.

There are many signs of the Eskimos' earlier habitation: old tent rings on the tundra and dozens of "stone men" on ridge lines and at narrows on the river. These piles of stone were usually erected as hunting blinds or as lines of dummy hunters to divert caribou toward an ambush. Possibly some were to mark food caches, or perhaps just to show that men had been there.

On clear days we had a view for many miles to a horizon of gray, green, brown and blue. The Barrens have a majestic vastness more appealing than the confining forest wall. That is, when the sun is shining. When it was overcast, cold and raining horizontally, the Barrens are grim and inhospitable.

Though devoid of trees, and with the precipitation of a desert (less than ten inches a year), the Barrens do not deserve the name. Little of the moisture runs off because of the low relief; nor does it soak in, due to permafrost. Sturdy grasses cover much of the tundra with wildflowers in sheltered places. We even found things to eat: low-bush cranberries, blueberries and cloudberries.

On the evening of August 14 we camped on the river bank between Aberdeen and Schultz Lakes. Shortly after we landed, a boat powered by an outboard engine came toward us, bearing an Eskimo man, his wife and their four children. They were the first people we had seen for 70 days, and we felt apprehensive. We were afraid of these strangers and embarrassed. We didn't know what we should say or do.

The Eskimo knew what to do. He stepped ashore, grinning broadly, and walked toward us with a chunk of caribou in his outstretched hand. That put us at ease. With the oldest boy serving as interpreter, we had a good talk about the eternal concerns of the North: food, weather and travel.

Four days later we reached the town of Baker Lake. There was no one to welcome us, no one to congratulate or reward us for the successful completion of our journey: 850 miles in 74 days through the beauty of the North.

In an age of thronged cities and enormous industry, we had traveled through an uninhabited wilderness solely by our own efforts, seeing sights that few are privileged to see—seeing the world as it looked when it was young. That will always be reward enough.

The first sight of fellow human beings comes after 70 days: An Eskimo family in an outboard motorboat marks the lonely journey's end.

Does Your City Recycle Garbage?

Location	Separation System	Estimated Annual Can Recovery*	Markets
Amarillo, Texas	after incineration	50 million	copper mines
Atlanta, Georgia	after incineration	100 million	ferroalloys
Chicago, Illinois	after incineration	730 million	copper mines
Franklin, Ohio	slurry system	30 million	steel making
Houston, Texas	dry separation at a transfer station	104-130 million	copper mines
Los Gatos, Cal.	after shredding, before incineration	120 million	copper mines
Madison, Wisc.	after shredding	38-41 million	steel making/ copper mines
Martinez (Contra Costa County), Cal.	portable separator at landfill	80 million	copper mines
Melrose Pk., Ill.	after incineration	83 million	copper mines
New Castle County, Delaware	after shredding	312-500 million	detinners/ steel making
Oakland, Cal.	portable separator at landfill	182 million	copper mines
Pompano Beach, Fla.	after shredding	35 million	to be established
Sacramento, Cal.	portable separator at landfill	74 million	copper mines
St. Louis, Mo.	after shredding, before incineration	260 million	pilot operation
St. Petersburg, Fla.	segregated by householders before magnetic separation	3 million	detinners
Stickney, Ill.	after incineration	84 million	steel making
Tampa, Fla.	after incineration	104 million	steel making/ copper mines

*Data supplied by municipalities or estimates based on 4% of total garbage less 20% for incinerator loss. Source: Survey by American Iron and Steel Institute as of mid-1972.

From Amarillo to Tampa, forward-looking communities are using magnetic separation to recover an estimated 2½ billion used Steel cans annually.

By the end of 1973, eleven more will join the list: Brevard County and Ft. Lauderdale, Fla.; Framingham, Mass.; Harrisburg, Pa.; Hempstead, N. Y.; Milford and Newington, Conn.; San Francisco and San Diego, Cal.; Scottsdale, Ariz.; Vancouver, Wash. That will add another 1.5 billion cans recovered simply and easily.

People in these communities become ecologists and conservationists when they buy beverages and other products in steel cans . . . and simply throw the empties into their kitchen garbage pails. Thanks to steel's magnetic quality, the used cans are mechanically extracted at municipal or regional landfill sites, transfer stations and incinerators. Magnetic separation saves fast disappearing landfill space and produces revenues from the sale of cans as scrap.

Properly processed scrap steel cans have four principal end uses:

- They are remelted to make a variety of new steel products.
- They are "detinned" in plants throughout the country to conserve tin (all of which must be imported) and provide steel for remelting or other reuse.
- They are used to extract copper from low-grade ore, thus conserving still another precious resource.
- They are used in the manufacture of ferroalloys—a basic ingredient in the production of new alloy steels and high-grade castings.

The steel industry's traditional use of millions of tons of scrap enables us to guarantee that the steel we make for cans contains at least 25 percent recycled material.

That's why we say that steel is the recycled material.

Steel
the recycled material

Tinplate Producers / American Iron and Steel Institute

By Paul Desautels

The gold thumb of a sculptor

Using the lost-wax casting process, a late-blooming artist reproduces plants in gold, on view at the Smithsonian

Simon Yavitz casts real plant parts in 18-karat gold to produce his intricate botanical sculptures.

There is a marvelously ingenious lost-wax casting process developed by the ancients. Mention of the process tends to conjure up images of a mysterious technique, used ages ago, which has been lost and cannot be duplicated. Actually, it is only the wax that is lost and not the commonly used process itself. The ancient Greeks and Chinese knew how to go about lost-wax casting more than two thousand years ago. Much later, during the Renaissance, this casting art reached its highest state of development as is attested by the astonishing works left us by the master craftsmen of Florence, Pisa and Siena. Benvenuto Cellini himself served his apprenticeship with a Renaissance goldsmith of Pisa, and thereafter it wasn't too long before he became the most celebrated goldsmith in all Italy and the one best remembered by us. Without the lost-wax process he would never have been able to produce his world-renowned work. His success was based on sculptural ability, high esthetic sense and mastery of gold-casting skills.

Very simply, lost-wax casting entails preparing a wax model, embedding the model in suitable heat-resistant, plasterlike material with a small opening from model to surface and then firing the entire assemblage in a furnace. The wax is burned off, leaving a perfectly detailed empty mold in the fired, and now hardened, plaster. The empty mold is subsequently filled with molten metal and allowed to cool. Then the mold is broken to remove the finished casting which is a faithful duplicate of the original wax model.

Of course, modern technology has seized on this basic process and refined it to the point where no dental laboratory would think of preparing inlays and bridges without it. Doctor William H. Taggert, an American dentist, was given credit in 1907 for perfecting a method of preparing a wax model of a tooth replacement and making a faithful casting in gold by the lost-wax method. He was able to improve the faithfulness of the casting by forcing melted gold into the mold by centrifugal casting. It took another 30 years before jewelry manufacturers began to adapt the process to mass-produced jewelry.

Jewelers discovered that all they needed was a handcrafted ring or another jewelry piece in either metal or wax. From it a rubber mold could be made and with the rubber mold an unlimited number of wax castings of the faithfully reproduced piece could be turned out. In quick time, then, hundreds of duplicates could be cast in precious metals by the lost-wax method. New wax injectors, electrically heated wax sculpting tools, plasters that are stable but quick hardening at high temperatures, vacuum chambers to remove air bubbles from the plaster, special furnaces, small but efficient rotating centrifugal casting machines and various precious metal alloys are among the later developments that helped to refine and perfect the ancient process. The modern artisan can now produce castings of consistently high quality in any quantity he desires. They would have been the envy

This four-inch-high work represents a sedum, in solid gold, growing on a piece of petrified wood.

of his predecessors throughout two thousand years.

With the craft developed to such a high state and so widely used in the jewelry and dental industries, the stage was set for artists to resume working in the medium of lost-wax casting. Many did so and among them was Simon Yavitz, who probably was as much surprised at the result of his efforts as anyone. He had given up thoughts of a stimulating and productive career in art nearly half a century earlier. His family and friends had never thought of him as either artist or craftsman.

Born in 1895, Simon Yavitz grew up in Vilna, which had been a leading center of Jewish culture in Eastern Europe until the disastrous German occupation in 1941. He was stimulated by his surroundings in this city to form artistic interests that would finally blossom at the age of 50 years. The word "blossom" is remarkably apt in this instance because the form of his delayed artistic expression was to be an extension of a longtime interest in living plants.

Any very early yearning for the life of an artist was soon snuffed out. Parental encouragement and, eventually, a short period of instruction as a student of the son of the Russian sculptor Mark Antokolski were all he had. When his father died, Yavitz was forced to work for the support of his family. Though abortive for the artistic career, his new responsibilities led directly to a successful career in industrial management. All of this stood him in good stead and helped him to help others when he finally left his homeland years later to join the new social experiment in Palestine. For 20 years he labored there, managing several large land developments, active in city planning and helping to convert desert lands to farms and orchards. He saw and helped Palestine develop into the modern state of Israel.

It was not until 1946 that the decision was made to abandon a fruitful business and devote full time to the long smoldering interest in art. Meanwhile he had enjoyed years of far-ranging travel and through them had studiously reinforced his knowledge and interest in both botany and the craft of precious-metal casting. Leaving Palestine, the budding artist flew to New York where he could get training in precision metal casting. In one and a half years he had absorbed about all there was to learn and prepared for a return to Israel. The scheduled trip was never destined to materialize. He had a heart attack and, although recovery was good, Simon Yavitz decided to settle permanently in New York. By 1960 complete retirement from business gave him the time to indulge what his friends tended to think of as merely an older man's whim. At least it gave him something to do in the idle hours of his retirement.

Ingredients for something unusual

Few seemed to realize that the industrial management expert now had in his hands all the ingredients for doing something unusual. He had a thorough knowledge of and the necessary equipment for precision metal casting. He also had a strong esthetic sense, a rich imagination and a general knowledge of natural history with special appreciation for living plants. The synthesis of all this knowledge and taste was a decision to assemble sculptural creations using gold and silver castings, usually of living plant materials, in combination with whatever mineral and gem pieces—cut or left in their original rough form—struck him as esthetically appropriate.

Somehow it would seem more suitable if his workshop-studio-laboratory resembled an alchemist's den transported from the Middle Ages. Instead, the inner sanctum of his workshop is an almost sterile, laboratorylike room with pseudosurgical instruments deployed in rank and file with a place for everything and everything in its place—pliers, calipers, drills, files, saws and other instruments and equipment for every metal-working process. By contrast, the elegant, spacious and beautiful apartment which he and his wife

Paul Desautels is curator in mineralogy at the Institution. His articles on both minerals and gems have appeared in SMITHSONIAN.

Botanical sculpture in precious metal

share is made comfortable and homelike by all the necessary touches, including a goodly share of living, growing plants.

Currently 20 examples of Yavitz's sculpture are on display in a special one-man exhibition in the Hall of Gems of the Smithsonian's Natural History building. All of the works represent botanical subjects. Several also make use of mineral and gem materials as accessories. In every case the plant materials have been reproduced in extraordinary detail in 18-karat gold or silver. Since the sculptures vary greatly in size, from dainty miniatures to relatively large bonsai trees ranging up to 14 inches tall, some of his precious-metal casting has to be done in sections. A few of the pieces, because of their size and intricacy, required more than 20 individual castings which were then joined together with gold solder and adapted to their bases in the process. The artist has often taken months, and sometimes years, to complete a single composition which meets his own critical standards.

Now and then, for the sake of the art, it was necessary to take certain botanical liberties. However, there are no grotesque inventions and all the plant parts are readily identifiable by plant specialists. Even with the few composite assemblages of plant parts there is transmitted a feeling that even if nature produced no such plant she might have done so with a little effort and perhaps should have.

Of the growing number of people turning to arts and crafts with an increase in their leisure time, Simon Yavitz fortunately had the knowledge, esthetic sense, the time and the means to seize upon the ancient lost-wax casting technique and use it successfully to meet his artistic aspirations. The sculptures on display in the Hall of Gems certainly attest to the fact that the use of precious-metal casting as an art form did not die with the ancients.

A miniature pine (above), with clusters of needles and twigs cast in gold, rises from a chunk of sodalite. Below, a juniper sprouts from an amethyst.

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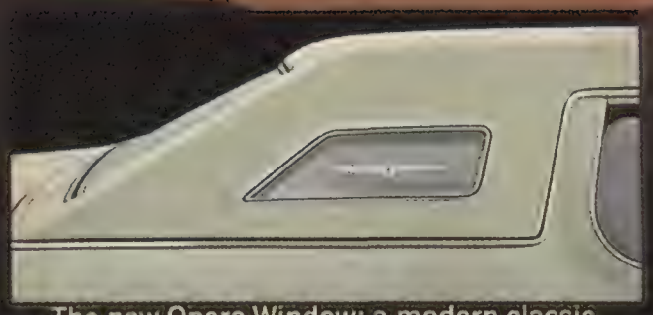

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By Joseph E. Brown

Rainmaking is now almost a science but its legal status is still murky

Weather control has moved from Indian dance to medicine show to laboratory, but cries of protest are replacing the old hocus-pocus

There have always been complaints about the weather, but now that men are doing something about it, a whole new variety of complaints is arising. Recently, Congressional hearings were held over the use by the United States of weather-modifying techniques in waging the Vietnam war. Arguments over weather control started before the war and will continue afterward and this article discusses only peacetime methods and problems. The science of making rain and slowing down storms has always produced its own tempests, involving crackpots, serious scientists, lawyers and, lately, environmentalists.

A classic case occurred in New York City in 1950 during a severe water shortage and drought. A faint ray of hope dawned when Dr. Wallace E. Howell, the city's consultant meteorologist, agreed to try to make rain artificially, employing techniques believed scientifically feasible four years earlier. By seeding supercooled clouds over the Catskills with Dry Ice, Dr. Howell explained, they would produce precipitation, fill the rivers and reservoirs, and end the drought. The reaction was as immediate as it was unexpected.

Upstate in Albany, Mayor Erastus Corning immediately charged that, while New York's cloud seeding might indeed bring rain, it might also jeopardize the state capital's supply. In Jersey City, Michael A. Fiore, a former instructor in meteorology and aeronautics, suddenly found a hot campaign issue in his race for Congress. Fiore charged that New York's rainmaking efforts might not only deprive upstate areas "of their proper share of natural rainfall," but would affect New Jersey and Pennsylvania as well.

Some objectors threatened to sue the city for reducing the chances of natural rain. A country club in the Catskills charged that New York's plan "will produce inundations, will make the streams in the Catskill watershed swell inordinately and cause considerable damage to riparian owners along such streams."

Joseph E. Brown, a Californian, left the editor's chair at Oceans *to become a free-lance writer.*

Cartoons by Michael Ramus

Unlike the old rainmakers who rode off into the sunset, modern weather wizards seldom escape unattacked

New York's city fathers pondered their curious dilemma: On the one hand, they were being accused of preventing rain in one place, and, on the other hand, of causing too much elsewhere.

Finally, in a decision that may become a precedent, Judge Ferdinand Pecora denied the injunction sought by the Catskill resort. The benefit from rainmaking to ten million thirsty citizens outweighed any private harm that might be done. Despite the decision, lawsuits totaling $2,138,000 eventually piled up against New York City, but a drought-ending statewide downpour which soon followed apparently cooled even the hottest of tempers.

Since then, a lot of rain has fallen from the clouds over New York and the rest of the nation, an increasing amount of it man-made. From a token budget 20 years ago, the federal government's investment in weather modification alone now exceeds more than $20 million yearly. While that is a pittance in terms of government spending, it is nonetheless impressive for a science newer than the harnessing of atomic energy, and far less proved. Cloud seeders, for instance, have

Benefit to cost ratio of 30 to 1 is good in anyone's book

yet to prove scientifically how much rain might fall in a given area *without* their efforts.

Whether proved or not, this young science today employs such sophisticated tools as computers, radar, radiosonde and spectroscopy. In one continuing experiment, rain-inducing chemicals aren't merely dumped into clouds anymore; they're shot through compressed air nozzles at nearly 1,000 mph. Meteorologists claim they are nearing breakthroughs in fog dispersal (to the encouraging applause of U.S. airlines to which fog is more than a $100 million annual headache of delays, diversions and cancellations). They are experimenting with techniques that will shift hurricanes, weaken hailstorms, take the sting out of lightning, even control whole storm fronts.

Yet as the science of weather manipulation has advanced, the measurement of its environmental, economic and human effects has trailed far behind the technological expertise. Legal quandaries, such as New Yorkers found themselves in more than two decades ago, are multiplying and appear no nearer solution even today.

Even if we had answers to such technical questions as whether seeding robs neighboring areas of their rightful precipitation, what then should the trade offs and the priorities be? Does the drought-stricken farmer, for example, have a right to "buy" rain which drives away sunshine-seeking guests at a nearby resort? Should mountain residents have to accept an unnaturally heavy snowpack they don't want even if it means economic salvation to a drier area in the lowlands? Doesn't weather manipulation also alter the biological environment it nurtures?

And, of course, perhaps even more significant, what has been the long-range effect on the climate itself by man-made pollution being dumped into the atmosphere? How severely are we *inadvertently* altering the weather? Although such questions are finally under serious study, a lot of Americans apparently aren't content to wait for answers. For instance:

- At Hungry Horse, Montana, the Bureau of Reclamation was utilizing cloud seeding to assure the Hungry Horse Reservoir of an adequate water supply for power generation during the summer months. It has been temporarily discontinued until environmentalists' questions are considered and resolved. One of the environmentalists' arguments: The added moisture would unduly increase the area's snowpack and

thus interfere with the migration of the region's elk.

• In Jeff Davis County, Texas, a group of ranchers went to court to protest a cloud-seeding project initiated by a group of farmers miles away. Their contention: Their own clouds were being "robbed" of rain rightfully theirs. A trial court judge accepted the argument, granted an injunction. The appellate court, however, modified the injunction to prohibit weather modification only in the area over the ranchers' land.

• In California, an experiment to disperse fog at Los Angeles International Airport was abruptly called off when airlines and neighboring residents claimed chemicals being used contained corrosive elements that might damage their property.

In spite of such reverses, and aside from environmental problems, artificial rainmaking appears to many to be one of the best bargains in science today.

Consider, for instance, the results of a single cloud-seeding project conducted last year in Florida as a joint effort of the state and the recently created National Oceanic and Atmospheric Administration (NOAA). About every other day during a 61-day period, aircraft went aloft to seed clouds that appeared to be rain-laden. Rain soon fell, 180,629 acre-feet of it during the two months. That was more than enough to soak a 3,000 square-mile area and help alleviate the drought.

Although NOAA scientists knew that not all the rain could be credited to the seeding, Dr. William L. Woodley, in charge of the seeding project at NOAA's Experimental Meteorology Laboratory in Coral Gables, Florida, estimated that at least 104,000 acre-feet "reasonably and conservatively" could be credited to the seeding. Using a value figure of $50 per acre-foot, Woodley then estimated that the man-made portion of the Florida rain was worth about $5 million. "For a cost of $165,000 the experiment produced a benefit to cost ratio of 30 to 1," he said, "and that's pretty good in anybody's book."

Within a few minutes of seeding a cloud, snow fell

Today, virtually whole states are covered by rainmaking operations with highly profitable results. In the period 1966-68 alone, the first two years in which federal law required reporting of modification projects, the National Science Foundation counted 180 to 200 such operations. There undoubtedly were many unreported projects as well. NOAA now keeps such records and a stiff fine is the penalty for not reporting a weather-modification operation. Conservatively, the National Academy of Sciences estimated in 1966 that cloud-seeding projects in the eastern United States increased precipitation between 10 and 20 percent; one private utility company alone, Southern California Edison, figures that snow runoff to its hydroelectric plants in the southern Sierra Nevada mountains, helped by man-made rainfall, has been increased 8 percent since 1951.

What do these increases mean in dollars? A study in southwestern Nebraska showed that each one percent increase in rainfall meant an additional $160,000 crop income to farmers; this did not include the potential of improved pasture and range area that supports much livestock.

Rainmakers tried to shake it down

Meteorologist Irving Krick, a California consultant specializing in long-range forecasting and rainmaking, has estimated that the air over the United States contains six times as much water as all the major rivers of the country, yet less than one-tenth of it falls to earth naturally. "Just think of what that would mean," ponders Krick, "if only just a little more of it could be brought down."

In many ways, man has been trying to do just that almost since the beginning of history. American Indians burned tobacco, danced and used medicine sticks as an offering to their rain god; Peruvian natives starved a black sheep until it rained and sacrificed alpacas. Early rainmakers apparently thought the most effective way to make it rain was to literally shake it down. Benvenuto Cellini describes how cannon were used to *avert* an impending rainstorm in 1539. In the 1830s, the French ordered soldiers to fire their muskets simultaneously to help end a drought. No one could say for sure whether the musketry helped. The United States Congress in 1891 set aside $9,000 for experiments that eventually brought General Robert Dyrenforth with balloons and dynamite to Texas. It rained, but the rain had been predicted anyway.

Possibly rainmaking's all-time champion was a promoter, dreamer, schemer and inventor named Charles Mallory Hatfield, who traveled the country in the early 1900s promising rain and earning fantastic fees for his labors. Hatfield, who died in 1958, objected to

the title "rainmaker." He preferred to be called a "moisture accelerator." "We assisted nature," explained his brother Paul.

His reputation glowing from a string of earlier triumphs, Hatfield in 1916 agreed to "accelerate rainfall" over San Diego County, California, which was suffering from one of the worst droughts in its history.

The San Diego City Council struck a bargain: If Hatfield could fill nearby Morena Reservoir within one year, the city would pay him $10,000; no one would question how much of the rain might have fallen *without* his help. Undaunted by the tremendous capacity of the reservoir, Hatfield went to work setting up mysterious towers from which smoke rose.

For several days, nothing happened. But when it began to rain, it didn't stop. After 26 days, 44 inches of rain had fallen, inundating the county. Bridges were swept away. Orchards were uprooted. Highways disappeared. The tragic climax occurred one day in late January when Otay Dam, straining under the weight of water, burst, claiming an estimated 20 lives.

Hatfield hadn't bargained for *that* much rain. Neither, obviously, had San Diego's City Council, which withheld payment of the $10,000. Almost a million dollars in claims against the city were filed, but the actions were dismissed on the basis that the rain was an act of God.

The modern scientific era of weather modification dawned in 1946 with cloud-seeding experiments of two General Electric scientists, Vincent J. Schaefer and Dr. Irving Langmuir, in the General Electric research laboratory in Schenectady, New York. Experimenting first with a cold chamber in the laboratory and then later in the atmosphere, Schaefer and Dr. Langmuir found that by introducing only a tiny piece of Dry Ice, or any substance colder than −40 degrees C., ice crystals could be produced in supercooled clouds. On November 13, 1946, the breakthrough occurred. Within a few minutes after "seeding" a supercooled cloud over Mount Greylock, Massachusetts, snow fell.

What especially elated the jubilant scientists was the suggested economy and benefit to cost ratio of the procedure. To produce precipitation, not a great amount of seeding material was required, just a handful dumped in the right cloud at the right moment.

Seeking to broaden the theory, other scientists thought that ice-crystal clouds might likewise be formed with substances other than Dry Ice. They tried a variety of smokes, dusts and other foreign particles, without success. Finally, Bernard Vonnegut, now of the State University of New York, after experimenting with certain compounds, lead iodide and silver iodide, for instance, discovered that the smoke of silver-iodide crystals worked nearly as well as Dry Ice, apparently because the crystal structure closely resembles ice in the arrangement and spacing of component atoms.

Not everyone wants a change in the weather

Peering at the genie

Cloud seeding, both as a government venture and a private business, began to blossom. But so did the realization that the breakthrough could have enormous consequences. "No doubt the feeling," notes meteorologist Krick, "was like that of the fisherman when the genie towered so threateningly above him. The legal consequences of 'fooling with the weather' may well have seemed somewhat staggering."

Peering up at its own genie, General Electric issued an order forbidding personnel from conducting any rainmaking experiments; at the same time the company announced it would not enforce its patent rights to the process but would turn over the process to the federal government instead.

Project Cirrus, the first long-range, full-scale cloud-seeding research project in history, was a joint venture of the U.S. Army Signal Corps and the Office of Naval Research, with aircraft lent by the U.S. Air Force. Because of the need for pilots during the Korean war, the project was discontinued altogether in 1952. Nevertheless, the first substantial body of knowl-

Modifiers may tamper with property that isn't theirs

edge had been formed and promptly was made public, and the new science had governmental blessing.

A flurry of nonscientists meanwhile began scrambling for the silver lining they saw in supercooled clouds. By the early 1950s, Western ranchers by the dozens began installing inexpensive nuclei generators on their property, ordering quantities of silver iodide. "If they accomplished anything," says Krick, "it could only have affected people many miles away."

Despite growing sophistication of rainmaking technology, the stunts of such amateurs and the ghosts of the Hatfields continue to drive many serious-minded modifiers to the aspirin bottle. Add the increasingly vocal concern over weather modification's environmental side effects, the unanswered legal questions, and the inconsistency of legislative guidance, and many weathermakers feel caught up in a backlash that could seriously impair their future.

The growing popularity of the class action suit and increased environmental concern are turning many private weather-modification firms toward government-contracted research with its protective liability indemnification, instead of projects in the private sector. "The result is," says Arleigh P. Helfer, president of Meteorology Research, Inc., in California, "that at a time when we should be moving ahead with practical application of the science, we still are involved primarily in pure research."

Not everyone agrees. At the heart of most anti-rainmaking arguments is the suggestion that modifiers are tampering with property not rightfully theirs; although the courts vary in their opinions of "who owns the clouds," they generally agree on the ownership of what's in them.

"Who owns what's in the clouds?"

"All forms of natural precipitation," the *Stanford Law Review* asserted in a frequently cited 1948 opinion, "should be elements of the natural condition of land. Precipitation, like air, oxygen, sunlight, and the soil itself, is an essential to many reasonable uses of the land. The plant and animal life on the land are both ultimately dependent upon rainfall. To the extent that rain is important to the use of land, the landowner should be entitled to the natural rainfall."

To pinpoint the major sources of public opposition to man-made weather modification, the U.S. Bureau of Reclamation recently sponsored a survey of 1,420 residents in California's Fresno County, hub of the state's agriculturally rich San Joaquin Valley. The survey showed that opposition ran heaviest among low-education groups with little or no grasp of rainmaking technology and among individuals with strong religious convictions. Questioning of many Fresno clergymen, however, indicated that "there is nothing in the realm of weather modification which contradicts the teachings of those particular religions in question." Favorable attitudes toward weather modification were apparent when financial dependence upon good weather was involved.

Since GE's breakthrough in 1946, there have been about a dozen or so lawsuits that have reached the courts. Obviously no weather modifier is anxious to lose the one lawsuit that will establish solid legal guidelines to his detriment. "The embryonic legal regime of weather modification has only been partly filled by court decisions," says Howard J. Taubenfeld, a professor of law at Southern Methodist University. "Of the cases that have been decided, none answers many of the interesting legal questions one could raise, not to mention the questions of appropriate mechanisms of control, supervision, and fair sharing of the benefits and costs."

Modern weather control

Neither the states nor the federal government has legislated consistently in the field. Maryland, up until last year, banned all forms of modification while 21 states still have no laws. Congress has considered but not acted upon several regulation measures.

But while legal and legislative questions languish in limbo, the environmental ones do not.

In a study considered to be one of the most far-reaching yet, the National Science Foundation (NSF) concluded in 1968 that artificial rainmaking may cause vast biological changes over wide areas; beyond altering rainfall patterns alone, ". . . such major weather modifications may also alter the balance among species of plants and animals—with sharp declines in the numbers of some and inordinate growth in the abundance of others. In particular," NSF noted, "major weather changes may result in the rapid growth of certain weeds, pests, and vector-borne diseases."

The study suggested that further investigation be made of chemicals used in cloud seeding, such as the silver in silver iodide—one of the most widely used substances—because "little is known of the biogeochemistry of this highly toxic element."

Aside from chemistry, what of the human aspects?

". . . No means have yet been found," NSF noted, "to confine the effects of modifying the weather to those who desire the modification. One farmer may need additional moisture, but his neighbor may suffer considerable losses if such moisture falls on his land too. Similarly, the precipitation which enables the hydroelectric power company to increase its profits may also ruin the vacation of the tourist."

The National Environmental Policy Act, calling for environmental impact statements on all federal projects, is affecting the weathermaker, as it has the pipelayer, the road builder and the public utility. In Colorado, for instance, it was applied to the Bureau of Reclamation's widely heralded pilot Project Skywater in the state's San Juan Mountains. The goal of Skywater is to increase the runoff of the San Juans by 16 percent, increasing the flow in the Colorado River to fatten the supply in areas far downstream.

In its preliminary impact study, the bureau admitted that ecological changes will occur, but slowly; scientists from three Colorado universities, retained to study the impact, are particularly concerned now over the long-range effect of silver iodide being used as nucleating material in the seeding.

In La Porte, Indiana, it has been estimated that over the last 30 years rain has increased 30 to 40 percent and thunderstorm activity 40 percent—all because of particulate matter emanating from the area's steel mills. Lead particles from automobile exhaust emissions have been implicated in the heavier snowfalls and rain in parts of the Northeast. Scientists, too, are concerned that upper atmosphere pollutants are warming the climate of arctic regions, and a similar argument was made against the SST project.

Pollution, however, is not the only necessary ingredient for all inadvertent modification. As Bernard Vonnegut points out, the patterns of moisture rising into the atmosphere are likewise affected by the replacement of vast forested areas with fields and treeless plains. "These absorb and emit radiation quite differently; they retain and give up moisture differently," Vonnegut explains. "When we strip vast areas of land of their natural vegetation, as we have learned to our sorrow, the dried earth may blow off in the form of dust storms that can cross an entire continent and significantly reduce the solar radiation that reaches the earth." Dust storms affect rain patterns markedly, and electrical charges generated by blowing dust can cause lightning.

Guesswork and people problems

Meanwhile, despite advancing technology, rainmaking still involves a lot of guesswork; the success or failure of weather modification still often hinges on personal judgment. Ultimately, taking the guesswork out of weather modification may well depend on vastly improved knowledge of weather itself. "If we are to recognize the effects from any method of weather control," argues Bernard Vonnegut, "we must first have a good idea of what would have happened without seeding. And that is very difficult because weather forecasts often fail to tell in sufficient detail what will happen 'naturally' to large clouds and to storm systems.

"Would the rain have come anyway? Would the fog have disappeared without human intervention? Would the storm system have developed, collapsed, or, as hurricanes frequently do, roared off in another direction?"

Not long ago, Vincent Schaefer reviewed the progress made in the quarter century since he and Dr. Langmuir stood jubilantly in man's first scientifically induced snowfall. Then he took note of the increasing pressures, the environmental questions and the tangled legal problems.

"We have a fantastic job to do in the field of education," he exhorted, "or the 'people problem' will become insurmountable. There is already an attitude that there are vested rights to the atmosphere and that natural phenomena such as 'weather' should not be tampered with under any circumstances." Some of the heaviest opposition, he noted, originated in the Northeast, "where pollution seems to have already made noticeable changes in the cloud types which commonly occur. "We've got to withstand such criticism," Schaefer concluded, "because we know from experience that when we're closer to the truth than our critics, then and only then will we make substantial progress in the field of weather control."

Many weathermakers feel caught up in a backlash

Rainmaking still involves a lot of guesswork. Its success or failure often hinges on personal judgment.

By Graham and Heather Fisher

Farmer carries on amid jet aircraft

A bit of pastoral England gets a big dose of noise pollution when London's international airport screams around it

When Henry and Marjorie Piper first surveyed the picturesque, two-bedroom cottage in Burrows Hill Close, some 17 miles west of London, they thought that paradise had opened for them. White-painted, with a roof of red-clay tiles, it stood—one of seven such cottages—in flat, open countryside, looking out on fields, some grassy, one waving with grain. In the distance was a wood. A lane meandered across to the village of Stanwell, a mile away. Behind the cottage a stream grandly called the Longford River coursed lazily between natural banks.

Henry Piper, a farmer since leaving school, had always wanted a little place where he could keep a few chickens and turkeys, grow flowers for London's market stalls. Most of all, he wanted a herd of pigs.

Marjorie Piper signals that it's time for tea in the only language that gets through the jet noise.

Henry Piper quiets his horses as a son watches a jet landing—the cause of all the trouble.

"What do you think?" he asked Marjorie.

"Oh, yes," she said.

So the Pipers rented the cottage and the not-quite-three acres of land and moved in with their twin baby boys, Gary and Andrew, their furniture and their two dogs, Tinker, a collie, and Prince, a crossbred Alsatian.

That was just 12 years ago.

Today, seen in close-up, the trim little cottage, with its white walls, and with a small pink pig on a post beside the front gate, still looks idyllic—provided you have plugs in your ears, a clip on your nose and don't take a wider view of the environment. For the Pipers rural paradise has turned into a close approximation of hell.

The Longford River has been diverted and runs now some distance away—between banks of concrete. Where there used to be farmland, there is now a sewer works. The distant wood has been felled to make way for a gravel pit. The meandering country lane has been effectively sealed off by the perimeter track of London's Heathrow Airport, the world's busiest in terms of international air travel.

A quarter of a mile away is Heathrow's Runway No. 1, and where the grainfield used to be—only some 250 yards from the house—is Runway No. 5 and noise pollution (see SMITHSONIAN, July 1972).

Remove the plugs from your ears as you stand out-

The Fishers, a husband-wife writing team, live in Kent. Graham is author of The Royal Family.

The farm at Heathrow Airport

side the Pipers' cottage, and the din is head-splitting. Jet after jet taxis along the runway and sits there, engines howling, in a line that on the morning of our visit was seldom less than six. Remove the clip from your nose, and the stench of fumes is nauseating. Speech is possible only in shouted snatches between the roar of takeoffs. Even inside, conversation is often still drowned, windowpanes vibrate, Marjorie's best tea set and Henry's silver cups dance an occasional jig in the china cabinet.

With the monstrous jets of BOAC, Pan Am, TWA and others landing and taking off almost in his backyard—five jumbos (Boeing 747s) and a nonstop stream of lesser sizes were airborne in the few hours we were there—Henry Piper struggles to carry on at farming.

A placid, fresh-faced countryman, Henry Piper, at 42, thinks back over the years and longs for the day when he and his family can get right away. "The airport was always there, of course," he says. But it was a good half mile away when we first came here, and nowhere near so big and so busy. We never in our wildest dreams thought it would come to this."

During the first few years in Burrows Hill Close, Henry worked long hours to develop his small holding. He bought 25 pigs to fill the existing sties, cleared the scrub from the back of the cottage, felled some old apple trees and put down a blacktop surface on the yard so that it was no longer necessary to slosh around in the mud. He built a small conservatory on the back of the cottage and another block of pigsties, partitioned and insulated. He bought more pigs, built another piggery for their young; bought an old army hut, dismantled it, hauled it some 15 miles home and reconstructed it. He built barns and store sheds for additional feed as his pig herd grew. And grow it did—50 breeding sows, a squealing mass of 250 to 300 young.

On the fine topsoil adjoining the piggery, Marjorie raised pansies, lupines, forget-me-nots and sweet williams which were sold in London as planned.

Between them, they made their home picturesque and their livelihood prosperous. In 1967 Henry won the silver cup for the best pig holding in Middlesex County. In 1968 he won the cup for the best small holding of any kind.

But while the pig herd was growing, so was London. It pushed out, developed and swallowed more and more land. To make way for the sewage farm that is now neighbor to the Pipers, three of the seven smallholders in Burrows Hill Close had to surrender their land. Henry was left with less than an acre, then got his lost acres back because they weren't needed for the sewage farm. But the topsoil was gone; lupines and forget-me-nots wouldn't grow. The land was fit only for grazing now.

That was the start of the Pipers' troubles. Next came the extensions to Heathrow's runways so that the airport could cope with larger jets. Between the work on No. 1 and No. 5 came the perimeter track.

"They didn't even tell us they were going to do it. They just put it there and cut us off. We used to be able to go down the lane to the main road—no more than 300 or 400 yards. Now we have to go right around the perimeter, which means driving a mile to reach the same point."

Warned against putting up any more permanent buildings, Henry began selling his pigs. Only 20 are left and, when they are gone, the Pipers will keep only one or two at a time, fattening them for their own deep-freeze.

Farm animals show few effects

"I've gone over to horses and cattle instead. I've got 13 horses and 35 to 40 cattle I'm fattening for beef. About 250 turkeys are fattening for Christmas and usually I have about 100 chickens, too."

Curiously, the roar and stink of the jets seem to have little effect on the farm stock. Only freshly bought pullets seem at all disturbed. It takes them three or four weeks to settle in and start laying.

Again and again, as we talked, conversation came to an enforced halt, drowned by the jets lined up on Runway No. 5. Once, in a sudden lull, we found ourselves shouting at each other. "That often happens," Marjorie comments. "And then we see the funny side of things and laugh. But mostly it's far from funny. You can't hear the television when you settle down of an evening, and if the telephone rings you have to keep saying 'hold on a moment.' "

Perhaps the most disturbing part of the situation is the way families here have begun to adapt to fumes and noise. The Pipers' twin sons have grown up in this

cottage. They automatically pitch their voices high and loud when they talk. They also have devised a simple sign language. A hand to the ear means "You are wanted on the telephone." Forefingers held up to form a T means "There's a cup of tea ready for you." Forefingers and thumb forming a capital D means "Time for dinner."

Visitors, of course, haven't had the years to adapt. When the Pipers' young nephew comes, he's frightened and cries when the jets wake him in the night. Adult friends from Bournemouth were frightened, too. "We gave them our bedroom while we slept downstairs on the settee bed," Marjorie Piper recalls. "In the middle of the night they came downstairs. Their faces were quite white. 'Are those planes all right?' they wanted to know. 'They sound as if they're coming right through the house.' "

What is the noise level? The Pipers don't know for certain, though meter readings have been taken that showed it well above 100 decibels. Has it affected their health? With ingrained honesty, Piper shook his head. "Farmers are generally rather placid. I think the average city worker—anyone at all highly strung—would be affected."

Harry Perry, a grizzled octogenarian whose cottage is a bare 50 yards from where the big jets line up, tells us that he hardly sleeps anymore. "I go to bed about ten, but can't get off for the noise. So I lie there smoking my pipe. About midnight I get up, dress and go for a walk. I may get back about one and make myself a pot of tea before going to bed again. At half-past two I'm generally still awake and I go for another walk. Maybe at four I finally drop off, but at half-past five I'm awake again and get up.

"You can't watch television, listen to the radio or hear yourself speak on the telephone. I've seen ten jets out there revving up at the same time. The jumbos aren't the worst. The VC-10s are. They're nasty old things. When they rev up the whole place rattles. I've had tiles off, windows cracked, even a drainpipe down. If you're holding a tin bucket, the vibration goes right up your arm."

Why don't they all move to some place quieter? "In a sense, I suppose there's nothing in the world to stop us from getting out tomorrow," says Henry Piper. "We only rent this place. But I've sunk something like $15,000 into it, and no one in his right mind is going to take the yard and buildings. We can't get out and we can't settle down. One day the airport will take over all this land, and we'll get compensation. When? No one seems to know. We're just sort of suspended."

A small, added irony: Not one of the Pipers has ever boarded one of those jets that have invaded their lives. "And I can't say that we ever want to," says Marjorie.

Henry Piper and sons watch a landing airliner,
which seems about to clip the chimney of their home.

By Mary Cable

The prairie dogs need help, too

Widely regarded as pests, these engaging rodents are becoming fewer and now have preserves like truly endangered species

For the last year and a half, an unusual tourist attraction at Alcalde, New Mexico, between Santa Fe and Taos, has been luring motorists from their journeys. State highway signs point to "PRAIRIE DOG TOWN." From a distance the town looks as devoid of interest as the rest of the barren range that borders the highway, but inside the entrance gate a large signboard (below) informs the visitor of the habits and merits of the prairie dog, and beyond—stretching over 30 acres—are dirt roads for driving and prairie dog viewing.

It's not exactly Serengeti, but it represents an effort on the part of the New Mexico Bureau of Land Management of the U.S. Department of the Interior to protect a rapidly diminishing species. In view of the fact that prairie dogs have for years been systematically poisoned and otherwise destroyed by ranchers, often with the assistance of the U.S. Fish and Wildlife Service, and that this poisoning is still going on despite the hue and cry raised by conservationists, refuges such as this could serve eventually to keep the species going.

Ranchers dislike prairie dogs because their burrows sometimes cause horses and cattle to stumble and break

STATE GAME REFUGE
NO GUNS ALLOWED
PRAIRIE DOG TOWN
FLOOD DIKE & WATCHTOWER
FOOD & MOISTURE SUPPLY
CHOOSING A SITE
HOME BUILDING
Remarkable social animals, they live together in permanent 'towns' Numerous mounds mark burrow entrances 'dogs' eat the grass and scoop up soil for their mounds
HELP THE DOGS BY NOT DISTURBING THEIR HOMES
LISTENING POST
KICKING OUT DIRT
TOILET
DRY ROOM
used when chamber is wet
CHAMBER
PUSHING OUT DIRT
BULLDOZING
PACKING DIRT
TAKING IT EASY
Prairie dogs are wild animals. Watch them from a safe distance - they can bite. Some may carry disease. Wild animals need wild food so please dont feed them. Dependant on your handouts they lose their natural ability to survive.
U.S. DEPARTMENT OF THE INTERIOR • BUREAU OF LAND MANAGEMENT

The sign at the entrance to Alcalde refuge constitutes a primer of prairie dog behavior.

their legs, and because they eat grass that would otherwise be available as forage for stock. The first charge is undeniably true, the second debatable. Prairie dogs do eat a lot of vegetation, but they aerate the soil and spread seeds around as well. The land where prairie dogs have lived makes fertile pasture. If they are driven out, the soil becomes hard and, after a few years, the grass is less abundant. In the days when bison roamed the land, prairie dogs did their ecological bit to counteract the packing down of grassland by millions of hooves.

A prairie megalopolis

Some of the vanished natural marvels of our country are easy to imagine—skies darkened by the flight of migrating birds, for instance, or vast herds of bison. We have seen simulations in the movies; besides, the game of East Africa is still abundant enough to show us what our West used to be like. But the phenomenon recorded in 1901 of a prairie dog town covering more than 25,000 square miles and inhabited by up to *400 million* prairie dogs is mind-boggling, for there is nothing like it in the world today.

Early chroniclers of the western plains spoke of these towns with wonder and pleasure. Meriwether Lewis, of the Lewis and Clark expedition, wrote that a prairie dog town, seen from a distance, reminded him of a "beautiful bowling-green in fine order." Its grass was nibbled short and was therefore of a uniformly lighter green than the surrounding sea of prairie grass. There were always sure to be rattlers and other snakes in the towns, sunning themselves and apparently ignoring the prairie dog life around them. And, as Francis Parkman noted in *The Oregon Trail,* there were also "demure little gray owls [burrowing owls] with a large white ring around each eye . . . perched side by side with the rightful inhabitants." The little creatures made their homes not only on the fertile prairie, but in semidesert as well. "Frequently the hard and dry plain was thickly covered, for miles together," wrote Parkman, "with the little mounds which they make at the mouth of their burrows, and small squeaking voices yelped at us as we passed along. . . . Some of the bolder dogs . . . would sit yelping at us on the top of their mounds, jerking their tails emphatically with every shrill cry they uttered. As the danger drew nearer they would wheel about, toss their heels into the air, and dive in a twinkling into their burrows. Towards sunset, and especially if rain was threatening, the whole community made their appearance above ground. We saw them gathered in large knots around

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One of the Alcalde prairie dogs sits upright amid the grass that is the chief item in his diet.

Prairie dogs sit squirrel-fashion when they gather to eat; diet varies with species and seasons.

the burrow of some favorite citizen. There they would all sit erect, their tails spread out on the ground, and their paws hanging down before their white breasts, chattering and squeaking with the utmost vivacity upon some topic of common interest, while the proprietor of the burrow sat on the top of his mound, looking down with a complacent countenance on the enjoyment of his guests. Meanwhile, others ran about from burrow to burrow, as if on some errand of the last importance to their subterranean commonwealth."

To Western adventurers, the harmless and engaging prairie dog was a pleasant contrast to the perils of the unknown wilderness. The little beast is equally appealing to modern urbanites, perhaps because some of its behavior reminds them of their own. Monkeys are similarly fascinating, but they have the drawback of looking like unflattering caricatures of people. A prairie dog, on the other hand, is "cute"—a Walt Disney natural. He looks like a large, short-tailed squirrel and is, of course, not a dog at all, but a member of the order *Rodentia* and the family *Sciuridae* (squirrel). As one early explorer put it, "Its yelp, which resembles that of the little toy-dog, seems its only canine attribute." It weighs about two pounds, and has a squirrel's habit of sitting erect on its haunches and holding food in its front paws.

White-tailed prairie dogs live in grassy prairies and uplands; black-tailed ones prefer plains and semidesert. There are several subspecies of each. Before the West became settled, there were literally billions of the black-tailed variety. Yet the creatures produce but one litter a year of two to eight babies, which are regarded as a tempting meal by badgers, coyotes, bobcats, ferrets, large snakes and birds of prey. They are also regarded as a delicacy among the Navahos, who have been known to contract plague after skinning prairie dogs and coming in contact with plague-carrying fleas. Probably for this reason, prairie dogs are feared by many persons as plague-carriers, although in fact they are no more prone to the disease than other wild furbearing animals.

The appetite for prairie dogs was apparently not shared by pioneers. "Those who have been compelled by necessity to eat the creature say that the meat is extremely tough and unpalatable," reported one member of a Santa Fe expedition in the 1840s. However, he added: "Two men, whom we met returning home disheartened, told us they were preserved from utter starvation by a lucky shot at a dog, which, with a little flour, was their only sustenance for nearly three days."

The shot that procured this particular meal was indeed lucky, for the writer says: "During our whole travel we were never at any other time successful in a single shot, though we fired at the mounds repeatedly both with pistols and rifles as we rode along. . . . At the report of a rifle they are gone like magic into the earth, and scarcely a sign of them remains." This is the reason why poisoning has been found to be the only effective method of wiping out a prairie dog town. Western farmboys have always found it amusing to take potshots at prairie dogs but far more bullets than prairie dogs have been expended in this way. Even if an animal is hit, it usually succeeds in tumbling into its burrow, while its colleagues vanish from sight.

A prairie dog burrow is among the special wonders of nature. From its main entrance, a tunnel may de-

scend steeply for six or seven feet, then turn slightly upwards and continue for a distance of as much as 80 feet. About three feet below the entrance there is usually a "guard chamber," where an embattled resident may listen and judge what dangers lie overhead. Other rooms and side corridors lead from the main tunnel, and at the far end of it there is often a cozy nursery lined with soft grasses. The upward turning of the tunnel causes an air pocket and enables the inhabitants to survive drowning by heavy rains or by inundations of water poured down by human enemies.

With such a comfortable and ingeniously designed bastion, it is not surprising that the prairie dog is greatly concerned with property maintenance. He nibbles away all vegetation that grows within several feet of the burrow entrance, so that enemies cannot approach unobserved. Using his nose, he tamps the earth around the hole into a mound that will keep out water and serve as a lookout. And he is constantly bringing up debris from inside the burrow and pushing it away or incorporating it into the mound, leaving a neat and tidy dooryard. Like the equally house-proud beaver, the prairie dog has a strong sense of territory. One burrow or several neighboring burrows are the home of a "coterie," consisting of one or two males, several females and their descendants. When one prairie dog meets another in the feeding areas that surround the burrows, they exchange a kind of kiss—a touching of mouths and teeth—which is believed to be a means of identifying fellow members of a coterie. Friends may pause to groom one another, and have even been observed sitting side by side on their haunches, with a forepaw carelessly thrown over one another's shoulders. Strangers, on the other hand, are chased back to their own territory, although those in dire need of shelter, as when pursued by a coyote or a hawk, may hope for sanctuary in an unfamiliar part of the town.

At sunset of a fine summer day, all members of a coterie foregather in the open, apparently just to enjoy togetherness. "They are a wild, frolicsome, madcap set of fellows," wrote George Wilkins Kendall in his *Narrative of the Texan Santa Fé Expedition,* ". . . and appear to take especial delight in chattering away the time, and visiting from hole to hole to gossip and talk over each other's affairs. . . . On several occasions I crept close to their villages, without being observed, to watch their movements. Directly in the centre of one of them I particularly noticed a very large dog, sitting in front of the door or entrance to his burrow, and by his own actions and those of his neighbours it really seemed as though he was the . . . 'big dog' of the place [modern observers would call him the dominant male]. For at least an hour I secretly watched the operations in this community. During that time the large dog I have mentioned received at least a dozen visits from his fellow-dogs, which would stop and chat with him a few moments, and then run off to their domicils. All this while he never left his post for a moment, and I thought I could discover a gravity in his deportment not discernible in those by which he was surrounded. Far is it from me to say that the visits he received were upon business, or had anything to do with the local government of the village; but it certainly appeared so."

Public Enemy Number One

Like people, prairie dogs are sensitive to weather changes. When the weather is very hot or very cold or rainy, they pass much of their time indoors, where the temperature may vary but the atmosphere remains humid winter and summer. Abandoned burrows are attractive to other creatures—the aforementioned snakes and burrowing owls, as well as ferrets, mice and various insects—and become a sort of ecological melting pot. The black-footed ferret was once Public Enemy Number One to the prairie dog, but now, as a result of the wholesale use of poison in dog towns, this ferret has become an almost extinct species.

After feeding voraciously during the early autumn, prairie dogs retire underground for the winter months. On bright days the black-tailed variety come out to feed and enjoy the warmth, but the white-tails seem to remain dormant, if not exactly hibernating. The un-

Two prairie dogs seem about to exchange a "kiss," which is probably a way of identifying friends.

pleasant weather of February and March passes unnoticed: It is mating season. And the young are born 30 days later.

Prairie dogs are permissive and affectionate parents. As soon as the young ones are ambulatory, they are allowed out of the burrow and are to be observed playing tag, wrestling and cutting up in general. At first they are friendly to all. According to one writer on prairie dogs, David F. Costello, they "sometimes go around kissing every prairie dog they see." Adult members of other coteries are tolerant of such behavior, but as the young grow up, they are taught to be more discriminating. They learn to know their own territory and, since they are not remarkably fast on their feet, to stay near the burrow entrances.

The chief weakness of prairie dogs is intense curiosity. They are continually looking about, with eyes that have wide-angle vision, like a rabbit's, and contain orange coloration to protect from the glaring sun. Their hearing is acute, and it is almost impossible to sneak up on them, but they may linger too long in the open just to see what's going on. They have, however, a warning system that is understood by the whole town: a high, fast bark which means "Everyone into the burrows and don't stop to ask questions." Unlike rats, they have developed neither wariness nor immunity to poisoned bait, and it has proved their terrible undoing. Before long, it is possible that they will no longer exist independently; therefore, refuges such as the new one at Alcalde will become their last hope.

The Alcalde prairie dog town is still only a hamlet, with perhaps a hundred inhabitants, and is not expected to become much larger. Other towns may be observed by the public in national parks in the Dakotas and Wyoming. A seven-acre town at Mackenzie State Park in Lubbock, Texas, is said by the local Chamber of Commerce to attract more than a million tourists yearly. Given the prairie dog's amiable nature and lively sense of curiosity, he seems not to mind the role of tourist attraction. And although never again will there be those astonishing "bowling green" prairie dog towns of the old West, he may yet survive the depredations of humans because he amuses them.

Prairie dog pups emerge from the burrow at six weeks, spend their time playing tag and wrestling.

By Kurt Stehling

What it is like in a gas balloon

Three men's voyage proved mostly that ballooning is uncomfortable, frustrating, rugged, pollution-free and, well—fun

"A balloon, you said?" The voice on the telephone was guarded. These are strange days, and if a line were monitored, a career might be shattered if such inanities were overheard.

"Yes, Colonel," I replied. "I want to fly an old-fashioned gas balloon and carry an Air Force weather instrument—a clinometer. I have your name as contact."

The officer maintained his courtesy and seemed relieved when I promised not to call him, but to wait for him to call back.

For over a decade I had been urging scientists to carry experimental gear in manned balloon baskets. Those who study the Earth's terrain could, I reasoned, benefit from the environment of a balloon car, free of vibration and noise, except for the chattering of the aeronauts' teeth. I pointed out that several old-time net-covered balloons are flown regularly by balloon clubs and, since helium isn't readily available to them, these flights are made with explosive hydrogen or natural gas. Yet there has been no fatal accident in this country with inflammable gas balloons for the past 25 years. Hot-air balloons, incidentally, provide sport for many but are not especially useful to science because of a noisy gas flame overhead and a limit of about four hours of flying time.

Kurt Stehling, author of the article on balloon astronomy in the June 1971 SMITHSONIAN, *is a space expert as well as one of the dozen or so licensed gas balloonists in the United States.*

It took me several months to persuade people that I could fly several pieces of gear in a gas balloon safely and—even more excitingly for them—free. Why free? The Office of Naval Research would furnish helium on the basis that it was promoting its interest in scientific ballooning.

Late last summer our plans began to jell. My co-pilot, Don Overs of Westinghouse in Pittsburgh, made sure that the bag we had selected was gastight. It was in Akron, and Don went there weekends to check it out along with some fancy aircraft radio communication gear which had been lent us by Narco Scientific Industries. This excellent equipment consisted of a multichannel VHF radio transceiver (sender and receiver) and a transponder, a device which permits ground-based radar to "tickle" it, whereupon it burps a signal so that the radar operator can locate it. The U.S. Weather Bureau provided a long-range forecast, highly speculative, which indicated that a good time to fly from Sioux Falls, South Dakota, where the helium was, would be toward the end of October. The winds would then tend to blow away from the Great Lakes. We decided on Veterans Day weekend.

A couple of weeks before the date, I learned that Overs' car was not in shape to drag a 400-pound balloon system in a trailer all the way to Sioux Falls. I couldn't haul it either. Fortunately, Overs had an acquaintance in Pittsburgh, Fred Kissel, a hot-air balloonist who agreed to haul our gear—if he could ride the balloon with us. We hadn't calculated on a third man, but we felt we could make a long flight—a night and a day—with him. We didn't think about the logistical and social problems of having three men in a basket built for two.

The great day arrives

Early on Tuesday, October 19, Overs and Kissel left Pittsburgh. I left Washington on the 22nd. When I reached the small airport which was our launch site, I found Overs and Kissel unloading the bag. It was a cool, brilliant afternoon.

At a weather briefing I was told of patchy fog that night and next day and light winds that might blow us south or west. By 4:00 P.M. the bag was laid out on the ground, and we were checking its gas valve. The net was carefully stretched over it while helpful kids loaded sandbags and helped hook them on.

On the way to the launch site I had stopped to pick up groceries. On balloon flights there is a tendency to buy more food than is needed, and I had two big bags of gourmet food which we probably wouldn't eat. Unfortunately I skimped on drinks. Overs had brought a two-gallon tea jug, but my meager purchase of soft drinks and the colossal thirst which Overs seems to

get whenever he is aloft were to prove embarrassing.

By 6:00 P.M. the bag was fully extended above the basket with its wooden load ring and wooden toggles—a system unchanged since 1800. Sandbags restrained the rig. The press had not caught on to our flight plans, and we were not displeased. We had enough to do without having reporters tangling ropes or asking questions while we were trying to duck behind a bush for a last rest stop.

As is always the case, the wind sprang up, but did not reach the ten miles per hour cut off point for launching. At 6:35 P.M. we climbed into the basket and made a double check of the valve by pulling it briefly. Darkness had set in so we shone a light into the bag to search for rope entanglements. Spectators and helpers hung on to the basket as the balloon strained to get away.

But when I said, "Hands off," the balloon just sat there. We dumped several bags of sand, and I repeated, "Hands off." We rose an inch or so. Noting that the wind might blow us toward a hangar, we had the crowd slowly walk us to the center of the field.

At 6:37 I again said, "Hands off." With two bags of sand having been dumped, we felt the ever-incredible sensation of rising. Almost imperceptibly we gained height. Overs dumped another half bag. A few seconds later we were at about 50 feet drifting across the field, rising more and more rapidly. We hung our flashing red light and steady white light below the basket, along with as much gear as possible, since we were practically sitting on top of each other. We hung sandbags overboard, keeping a dozen or so inside the basket, since these have a habit of tearing loose when one lands. If that happened, the landing would turn into a rocketlike takeoff.

It was strange, in the darkness, to see all the shining faces below illuminated by automobile headlights. We heard shouts: "Good luck," "Good-bye." About ten minutes later we leveled off at 1,500 feet, where the balloon reached its pressure equilibrium. We settled down for a cold night in sweaters and flight suits.

With the basket free of much of the junk, we could move around a bit. I checked rigging, lights and sandbags for leaks; a bag leaking fine sand into food, instruments and eyes is a confounded nuisance. When a leaking bag is hanging overboard, spectators below may rub their eyes for days. The pilot also rubs his, wondering why he's rising.

Overs checked our instruments. We had a thermometer, a sensitive altimeter and a statoscope or rate-of-

Helping hands prepare basket while balloon strains to rise. Yet at takeoff time, it just sat there.

The great balloon adventure

climb meter which shows when the balloon is rising or sinking. In earlier days pilots used to throw out bits of toilet paper: When they rose, the balloon was sinking.

At about 8:00 P.M., Overs' radio check with the Sioux Falls airport tower brought in the voice of the operator, whose lack of enthusiasm for a night-flying balloon was clearly evident. Overs gave our approximate heading and switched over to receive. We waited for the operator's reply. Nothing—not even a crackle. The radio had died. (It later turned out to be only microphone and speaker failure—enough to prevent any communication.)

We decided not to panic. Aeronautical radios are, after all, a rare luxury on balloon flights, and we had walkie-talkie contact with the station wagon, which we wishfully thought was following us across the dark countryside. We turned on our set, called, jiggled knobs, turned dials—nothing.

Kissel pointed out that, militarily speaking, we must be the most secure aircraft in the world. We didn't have enough metal to be a target on a radar screen, and we emitted no trackable radio waves. To take our minds off our predicament we rooted around with flashlights in a basket darker than Tut's tomb. We checked wiring, battery terminals, various contacts and switches. Kissel blinked a big electric torch at the ground, hoping to get a response from our following wagon. Zilch. Just below us now was a small racetrack, probably a dog track. We yelled down lustily, "Hey—where are we?" Whatever absorbed the crowd below apparently prevented them from seeing or hearing us. Perhaps they didn't believe what they saw.

The racetrack seemed to be at the edge of civilization. An infinite black void appeared ahead. We estimated from a compass bearing, with a distant radio tower as reference, that we were moving south or south-southwest at about 10 to 20 miles per hour. A glittering canopy of stars curved around us down to the horizon. Exhausted by our labors, we squatted down on ballast bags. Moisture from the sand soaked our backsides. I consoled myself and the others that we would probably see some landmark soon. Anyway, I reasoned, if we became really insecure we could always land in this farm area using our big automobile sealed-beam spotlight to avoid power lines.

"I wouldn't want to try that, Kurt," Overs commented. "Look over the edge." I looked. The Weather Service's patchy fog was a solid overcast. We might as well have been drifting in outer space. We would just have to stay up. In an emergency, everything and anything, besides ballast, could be jettisoned. I wondered about Fred Kissel. After all, he's a bachelor. . . .

Steady dribble of hot tea

There was nothing to do but make the best of a hair-raising situation. One of us watched the instruments for two hours while the other two squatted on the floor, catnapping. The balloon seemed to need little ballast trim, staying steady at about 3,500 feet. Around 11:00 P.M. Overs was "watch officer." I heard him trying to pull up the two-gallon tea jug hanging below the car. Overs' thirst was phenomenal; he had already drunk several Cokes and a quart of water. A man not given to swearing, he cut loose when he grabbed the jug. He had hot tea all over his hands from a leaky faucet. We had been dribbling tea (precious ballast) for several hours. No wonder the balloon wasn't sinking, which is natural for it to do at night.

Kissel and I arose and shared the remainder of the tea with Overs—about a cup each. The balloon was sitting just above the fog bank like a cork on water; we in the basket hung 40 feet below in the icy cloud. Now and then the balloon would rise a little or the fog would lower and we would briefly see the stars and occasionally a meteor. Moisture gradually collected on the bag. This added weight and meant dumping ballast to keep us from settling completely into the cloud. Icy

Bag gradually fills with helium from pressure tanks at launch site—Sioux Falls, South Dakota.

water dripped into the basket and turned into rime.

By 2:00 A.M. the quiet was absolute—no ground noises from cars or trucks. The fog acted as a damper. It was Kissel's turn at the instruments, and he was so ungracious as to voice the unspeakable: What if an airplane were flying on instruments through the clouds? That was enough to wake Overs who puttered again with the radios with no result. I pointed out that no pilot in his right mind would be flying at our altitude.

Our sense of isolation was overpowering. After a while, Kissel asked, "Do you hear what I hear?" We listened. Then we heard it: a sound like a manhole cover being replaced somewhere. We yelled down—"Halloooo, where are we?" And again. We heard faintly "Who?" We yelled once more, and again, "Who?"

We'll never know what effect our ghostly voices had on the farm people below. Maybe we started a new chapter in folklore. We gave up yelling and silence enveloped us again, but every now and then we heard the strange "manhole cover" sound from below. I tried to sleep with Kissel's extra sweater wrapped around my head. Overs burrowed in the littered corners of the basket for soft drinks, and occasionally I would wake, startled, to hear Kissel chomping on a candy bar.

Floor beam cracks

Around 3:00 A.M. I took my turn manning instruments. Stepping across the floor I suddenly got the feeling that I would drop through. The 40-year-old basket had seen better days, and a two-by-four across its bottom had cracked. I had visions of tumbling down onto the dark, cold countryside while my colleagues, relieved of 190 pounds of (soon) deadweight, were rising 10,000 feet.

About half an hour later I woke the other two to show them a curious phenomenon. We had drifted into what seemed to be a colossal milky bowl with huge luminous walls. Were we over a city? Possibly, but what Midwestern city had that many lights on at 3:30 A.M.? We tried radios and the walkie-talkie. Then I remembered a small transistor AM/FM radio among my personal junk. I tuned in some stations—nothing except automobile, farm machinery and supermarket ads. By moving the radio around I picked up weak and strong signals from several stations. At 4:00 A.M. we listened for identification. Only a couple of stations gave their locations—Omaha, a place in Illinois, a couple of North and South Dakota FM stations. We determined from signal strengths that we were probably not in Canada and probably not over Illinois, but more likely over Nebraska or southern South Dakota. That was remarkably close, as we learned later.

We drifted out of the "bowl," and I decided we should get out of the cloud tops, ballast or gas supply

Jettisoning sand ballast, the author keeps basket above cloud bank. To descend he would open gas valve.

be hanged. Dumping some 15 pounds of sand gained us 500 feet or so. By 5:00 A.M. we were casting anxious glances at the east. By 6:00 we were all alert, vying for the first signs of sunrise.

Suddenly, Overs shouted, "It's coming." The first rosy silver appeared. We bowed to it like Aztecs. By 7:00 we felt its heat, and within an hour we were shedding our outer clothing. The balloon felt it and, as it superheated and its water film evaporated, it rose to about 6,000 feet. The clouds, now a couple of thousand feet below, extended to the horizon. Kissel noted a radio tower barely poking through in the distance, the first man-made object we'd seen for 12 hours. We seemed to be drifting west-northwest.

We began to take readings with the Air Force device and soon had several pages of data collected. The usual electrical short or disconnect problems cropped up, which meant constant wire tracing and checking. We downed the remaining food. A can of eggnog poured out with the consistency of ice cream.

The transistor radio now picked up Saturday morning farm and weather broadcasts which gave us the

The great balloon adventure

cheery news that the early morning fog blanketing the Midwest and halting airline travel would continue into the afternoon. The station location was Aberdeen, South Dakota. With little left to drink and no radio contact, I decided on an afternoon landing, conditions permitting. I gave up any thought of flying through the next night, although there was plenty of ballast left.

By noon I noticed dark patches in the white canopy, and within an hour these began to expand. We could probably have descended through the fog, which is less dense once you are in it. However, a clear landing site is still preferable, even in daylight. By 2:00 P.M. the dark patches extended all around us, and we began to see amorphous surface features.

Almost any idiot can take a balloon off in still air. It takes a trained idiot to land one without breaking his legs, tearing up power, telephone or wash lines, uprooting trees, sliding off roofs or sinking into a body of water. As we prepared to descend we peered anxiously through the cloud breaks for evidences of civilization and nature's booby traps—sharp, high rocks or water. The balloon passed through the 3,000 foot level in response to Overs' one- or two-second valving every minute or so. We approached 1,000 feet. Everything loose or valuable was stowed. I dumped a bag of sand to slow our accelerating descent. We could see the countryside now through the disappearing fog—brown tilled earth, no major power lines or protuberances. The wind was blowing us toward a couple of white farm buildings. With careful sand-gas manipulation we might land nearby.

Kissel, who had chosen this inappropriate time to use our rudimentary toilet facilities, vouchsafed that hot-air bags come down more gracefully. What he meant was, slower. In truth, the ground was rushing up at a disheartening rate, while the surface wind of about 10 to 15 miles per hour was propelling us speedily across country. We could now see minor obstructions coming at us as we whistled down and across the fields—boulders in a gully, telephone wires along a dirt road over which we hopped. The ground rushed at us like a speeded-up movie scene. Overs stopped valving, Kissel and I stood ready for emergency sand dumping to let the balloon sail over obstacles. *IMPACT!* Despite our parachute stance on balls of feet with knees flexed, we were forced to our knees as the tough old basket creaked and groaned. We bounced up 100 feet, Kissel having prematurely dropped half a bag of sand. Then, with valve held open, we came down again. *IMPACT TWO!* We bounced up again about 20 feet. Hanging onto the basket, I yelled to Overs to pull the rip panel. He did, and we ploughed into the side of a small hill.

With its top ripped open, the balloon got tired of this nonsense. We hit again just over the hillock's crest, the basket dragging on its side for about 50 feet while the bag flattened itself on the ground. Thus three bedraggled aeronauts landed on Mother Earth.

The basket had tipped over, and all our junk was scattered over us. Overs had his foot in Kissel's beard. A liquid was running down my neck and throat. Horrified, I thought, I'm bleeding, but this was cold, yellow and sticky—the remainder of the eggnog. Our "leakproof" acid battery was also sending a little Niagara Falls across our equipment.

Facing a gun-carrying farm boy

We rolled out the battery, untangled ourselves and crawled from the basket. Those farm buildings were still at least half a mile away. While my colleagues began to clean up and unravel ropes and gear, I trudged across the fields toward a dirt road that would lead me to the houses, which I hoped were occupied by people receptive to my powers of persuasion. We had several hundred pounds of gear to pack up; we didn't know where we had landed; we had to phone our Sioux Falls contact, Mike Pavey. I could only hope that he was home and that we were not so far away that it would take him a day to pick us up. Lastly, I had to persuade the farmer to transport us to some place where Pavey could find us.

Approaching the road I noticed a couple of parked cars with bewildered faces peering intently at me. I didn't realize then how odd it must have seemed to farm people, minding their own business, to see a silvery globe plummet through the clouds and disappear behind a hillock, and then find me striding toward them in my orange flight suit and straw hat. I noticed they had left their engines running. The bluish barrel of a shotgun stood upright in one car's

window. Remembering 19th-century aeronauts' confrontations with superstitious peasants armed with pitchforks, I raised my straw hat and tried to smile broadly. The front car's window rolled down, and a lady asked apprehensively, "Can we help you?"

"You surely can, Ma'am," I replied heartily.

An older man in the front seat, leaned over and asked, "Who are you and where are you from?" The second car's windows came down and a middle-aged couple and a teen-age boy (holding the shotgun) strained for my reply.

"We're balloonists on a scientific mission who had to land since our radios quit—and I'm from Washington," I added importantly. In a farm-subsidy conscious area, being from Washington impresses most people. "But, where have we landed?"

Voices chorused that we had landed in Eureka.

"Which Eureka?" I asked, envisioning the only Eurekas I knew, one in Kansas and one in California.

"Why, Eureka, South Dakota." The lady tried to conceal her astonishment that scientists from Washington didn't even know what state they were in.

Relieved, I shook hands all around. The couple with the boy insisted I get in with them, so that he could question me. I might add that his shotgun was now discreetly tucked away. The two cars took off while I regaled my hosts with stories about ballooning, hinting mysteriously at important projects.

We arrived at the farmhouse of Otto Schick. He let me use his phone to call Pavey. I had imagined Pavey and company, frantic in Sioux Falls, and an alarmed country searching for us. Nothing of the kind. Mike was watching the Saturday football game on TV, and my phone call disturbed him. He confessed that, after losing us in the fog, he had gone home, secure in the knowledge that staying aloft through the night and landing safely was *our* problem, and there was nothing he could do about it.

I proposed, somewhat testily, that he pick us up that evening somewhere in the middle of Eureka, Mr. Schick's farm being unlocatable in the dark. I presumed that Eureka was no metropolis, and we would be highly visible. Pavey generously agreed to set right out on the 200-mile trip.

A couple of hours later, thanks to Mr. Schick's generosity, we were standing watch at the only crossroad in Eureka when a police cruiser pulled up. The officer looked us over—Kissel with his straggly beard and scruffy sweater, Overs with his arms in the sleeves of his red flight suit, while the legs flapped behind him like swallowtails.

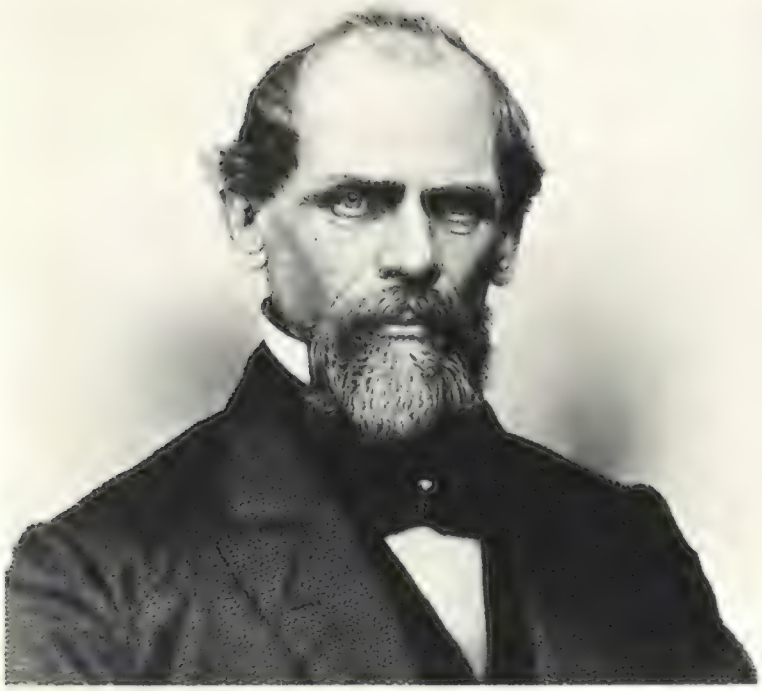
The policeman carefully asked where we were from.

From a balloon, we told him.

Only at the mention of Otto Schick did he take his hand off the emergency distress button of his radio.

Kissel's station wagon soon roared into town with Pavey at the wheel. We opened a bottle of cognac, which Pavey had thoughtfully brought along and, right in the middle of dry Eureka, we toasted Otto Schick, the Law, the marvelous hospitality of these rural people who had helped us stow our gear, and balloon flights past and present.

Capsized basket marks end of the 200-mile flight—longest in recent times with a three-man crew.



John A. Roebling, visionary German immigrant, created a wire empire and contracted to build Brooklyn Bridge. On his death, job went to his son.

Col. Washington Roebling, Civil War hero, took over the work his father began. He battled ignorance, graft and crippling illness to complete the bridge.

The old dream of a Brooklyn Bridge came true May 24, 1883 when at last it was officially opened. Fourteen tons of fireworks—more than 10,000 pieces—lit the sky that night.

By David McCullough

The Roeblings: their great bridge fulfilled a dream

The job cost the father his life, the son his health, but in 16 turbulent years they attached Brooklyn to New York City

Old Man Roebling, as the men at the mill called him, was Trenton's first citizen. The town had seen him build his wire business from nothing, raise seven children, bury two others and one wife, then marry again when he was past 60. He had survived hard times, fires, cholera epidemics, the hazards of bridge-building, accidents at the mill and his own particular notions about maintaining good health.

Come headaches, constipation and the ague, he would sit in a scalding-hot tub for hours, then jump out and wrap up in ice-cold, sopping-wet bed sheets and stay that way for another hour or two. He drank vile concoctions of raw egg, charcoal, warm water and turpentine. "A wet bandage around the neck every night, for years, will prevent colds . . ." he preached, "*a full cold bath every day* is indispensable. . . ."

It was common knowledge that he was an inventor as well as an engineer, that he was an artist, that he wrote prolifically for scientific periodicals, that he read Emerson and Channing and other freethinkers.

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Bridges were what he was best known for, of course, although his fame in Trenton was as an industrialist. He was internationally praised as the engineer on four major bridges.

A bridge over the East River joining the cities of New York and Brooklyn had been talked about for nearly as long as anyone could recall. But the problem was the East River, which is no river at all technically, but a tidal strait. "If there is to be a bridge," one comment ran, "it must take one grand flying leap from shore to shore over the masts of the ships. There can be no piers or drawbridge. There must be only one great arch all the way across."

In April 1867 a charter organizing a private company to build and operate an East River bridge had been approved at Albany. A month later, Roebling had been named engineer of the work. It was to be the largest suspension bridge in the world, crossing the East River with one uninterrupted span, held aloft by huge cables slung from two colossal towers and secured on either shore to massive masonry anchorages.

After giving him the job, Roebling's Brooklyn employers had seen very little of him. Their day-to-day dealings had been with his son, Washington. The father had remained in Trenton, showing up in Brooklyn only now and then. On occasion the two of them, father and son, would be seen walking on Hicks Street, talking intently, or down by the slate-gray river, the father pointing this way and that.

Then, on June 28, 1868, John Roebling was involved in an accident which, though extremely painful, seemed of no serious consequence. He and Washington had been working beside the ferry slip, where the Brooklyn tower was to go. At one point Roebling was standing as far out on the ferry slip as he could get, atop a cluster of piles. Seeing one of the boats approaching, he stepped back onto a beam, but something caught his right foot. The boat ground against the rack, crushing the top of his boot and his toes. The pain must have been excruciating, but he went on shouting directions until he toppled over.

Washington rushed him to a doctor's office where his father was no sooner in the door than he was telling the doctor what to do. Other doctors were called in and it was agreed that his toes would have to be amputated. Roebling promptly consented and requested that the operation be performed without anesthetic. When it was over, he insisted on binding the wound himself. Then he was taken to his son's house.

On July 8 the Brooklyn *Eagle* reported that he was busily engaged on his plans for the bridge, and that the injured foot had been so placed that a steady stream of cold water poured over it. But in another week he had taken a turn for the worse, showing the unmistakable signs of tetanus. On the night of July 21, Roebling died.

Years later it would be said that his death left everyone with doubts about going ahead with the Brooklyn Bridge. But the truth is there was never any doubt. Roebling had long since talked about his son replacing him eventually. Washington Roebling would take up

David McCullough wrote The Johnstown Flood, *now plans a book on building the Panama Canal.*

William Kingsley, left, Brooklyn's leading contractor, urged starting a bridge after the Civil War. He enlisted State Senator Henry Murphy, center, to support formation of a company in Brooklyn. Murphy later became its president. After John Roebling's death, William Marcy Tweed, right, emerged publicly as a big backer—and future profiteer. Boss Tweed, exuding charm from all 300 pounds, was every inch the grafter that Thomas Nast cartooned. He later claimed "understandings" with Murphy and Kingsley which would eventually have given his Ring control of the bridge. Murphy and Kingsley denied involvement.

Cutaway model of a Brooklyn Bridge caisson stands in the Smithsonian Institution. It shows the tapered walls that cut into the riverbed as stone blocks were piled on the timbered roof.

Men entered the caisson's high-pressure atmosphere through air locks. Many suffered bends because they surfaced too fast. Unlike these figures, the workers wore almost nothing in the humid air.

the engineering task right where his father left off.

At 32, he was both like his father and quite different. John Roebling was a European intellectual, a perfectionist and an aristocrat if one accepts his own belief in an aristocracy of ability. He was painfully proper, vile-tempered, and widely regarded a genius. His eldest son was even-mannered, informal, kindly, and, as he himself would say, just a little lazy by his father's standards. He was extremely bright, but not a genius. He was also a great deal more open-minded than his father had been. He was considerably more interested in his fellowman and, everything considered, much more of a human being.

The letters he wrote during the Civil War reveal much about the young man. Washington Roebling said little about his own exploits, but he seems to have had a gift for being on the spot when needed. At Gettysburg, as aide to General Gouverneur K. Warren, Roebling was the man who spotted the Confederate advance on Little Round Top in time for the Union troops to protect the hill—an action many historians view as a turning point of the war. Long after, he gave this account:

"Arriving at the foot of the rugged little knob, I ran up to the top. . . . One glance sufficed to note the head of Hood's Texans coming up the rocky ravine which separates little and big Round Tops. I ran down, told General Warren, he came up with me and saw the necessity of immediate action."

Warren, understandably, got nearly all the credit. Roebling was characteristically laconic. "I was the first man on Little Round Top. There is no special credit attached to running up that little hill, but there was some in staying there without getting killed."

Emily Warren came into his life on February 22, 1864, at the Second Corps Officers Ball, which had been held in a huge wooden hall especially built for the occasion under his supervision. "In point of attendance," he had written his sister, "nothing better could have been desired; at least 150 ladies graced the assemblage, from all quarters of the Union, and at least 300 gentlemen from General Meade down to myself." The occasion was a grand success.

"Last but not least was Miss Emily Warren, sister of the General, who came specially from West Point to attend the ball; it was the first time I ever saw her and I am very much of the opinion that she has captured your brother Washy's heart at last." In January 1865 he and Emily were married.

In the months immediately following his father's death, Roebling was exceedingly busy. His most vital concern was the giant caissons which would serve as the foundations for the two towers. The easiest way to explain how a caisson would work, Roebling found, was to describe it as a huge diving bell of wood and iron, shaped like a gigantic box, with heavy roof, strong sides and no bottom. Filled with compressed air, it would be sent to the bottom of the river by building

up layers of stone on its roof. The compressed air would keep the river out and make it possible for men to go down inside to dig out the riverbed. As they progressed, and as more stone was added, the box would sink until it hit a firm footing. Then the interior would be filled in solid with concrete.

As work progressed on the first ungainly structure, two air locks, two so-called supply shafts and two water shafts were being built into the timber roof. The air locks were made of half-inch boiler plate. They were big enough to pack in about a dozen men, who would enter through an iron hatch. The hatch closed, an attendant inside would open a valve releasing compressed air from the work chamber below into the lock. As soon as a gauge showed the pressure there equal to that below, another hatch in the floor would be opened and the men would climb down into the caisson. When it was time to come out, the process would be reversed. They would climb up the shaft into the lock.

The water shafts were a simple means by which mud and rock excavated inside the chamber could be hauled out with no loss of compressed air. The supply shafts were simply the means by which Roebling intended to get the necessary cement, sand and gravel into the caisson once the excavation was finished.

About 3,000 people turned out to watch the launching of the Brooklyn caisson in March 1870. As soon as the last block was split out, the giant mass went down straight and even, struck the river with just enough speed to overcome the resistance of the water and the air chamber worked to perfection, keeping the front side from sinking. The deck never even got wet.

By July better than 200 workers were going down in it every day, and naturally they had stories to tell. So a picture began to emerge of a strange nether world at Brooklyn's doorstep, entered only by men of superhuman courage, or by fools, and as sometimes happens

Demolition crews clear blocks of old houses to make way for bridge approach. Massive anchorage

bristles with derricks. Footbridge leads from it to the nearer tower. Beyond is the New York skyline.

with ideas that grow in the imagination, it was not so very far from the truth.

While investigating caissons in Europe, Roebling had heard of the mysterious sickness that sometimes affected workers in the compressed air. Men would suffer sudden sharp pains in the arms and knees, sometimes accompanied by chills and vomiting. As caissons went deeper, men would complain of severely painful joints and excruciating stomach cramps. Still, nine out of ten felt no pain whatever, and the phenomenon was not taken very seriously.

In Brooklyn, Roebling noted that the men who had caisson sickness, or "the bends," were new to the job. His treatment was to send them out of the caisson.

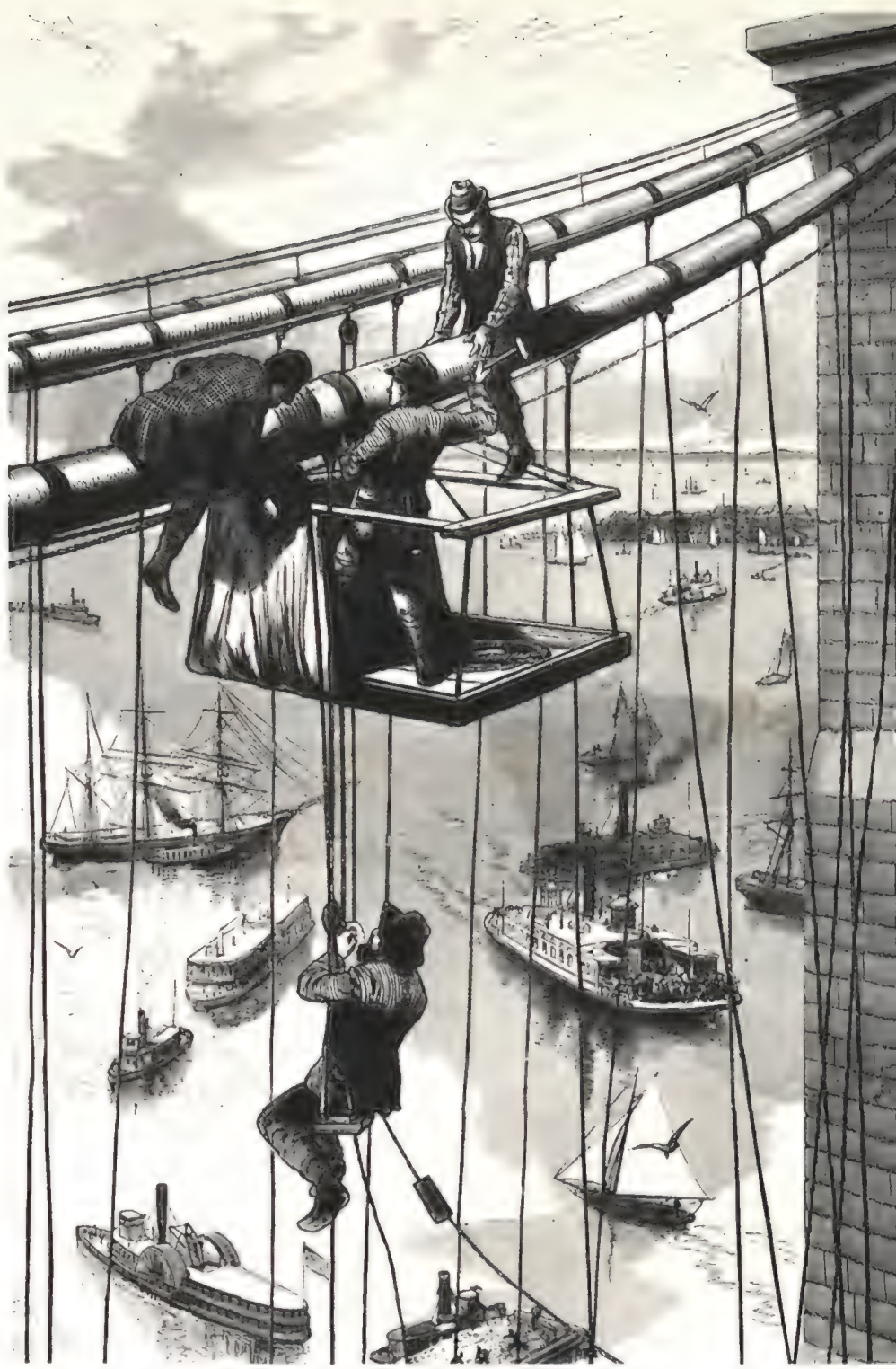
Fire in the caisson

Then on the morning of Friday, December 2, about the time most people were on their way to work, the news swept through Brooklyn that the caisson was on fire. Roebling was sent for, and by the time he had come down through the air lock, the hoses had been put into service and were enough to extinguish all the fire, or at least all anyone was able to see. In the dense atmosphere of the caisson, charged already with lamp and blasting powder smoke, it was impossible to tell what damage was being done out of sight, or to what depths the compressed air might force the fire into the layers of timber overhead.

Roebling worked feverishly with a few handpicked men; the rest he had sent back to their regular duties. He did not intend to lose a night's work unless he absolutely had to. The question of flooding the caisson came up. To put the fire out some less drastic way would be immensely preferable.

About three in the morning, water began to drip from the charred seam for the first time, suggesting that the compressed air had driven water into every possible crevice above, that the timber was now totally saturated for 15 feet up, and that the fire was at last out. Roebling was so exhausted he could barely stand. He had been in the caisson much of the previous day and had gone home that evening completely played out. The air was also bothering him a good deal. The men now urged him to leave. Then, about five, having decided that the fire was out, he had what appears to have been an almost total physical collapse. The accounts there are do not say exactly what his condition was, only that he had to be helped through the lock.

Apparently the sharp night air revived him some at first, but then suddenly he felt the beginnings of paralysis. In a matter of minutes he was unable to stand or walk. Nearby, the foreman, who had also been carried up through the lock about the same time, was in an equally bad state.



Cable stringers, many of them ex-sailors, swing high above East River as they attach wire suspenders.

Roebling was driven directly home. For the next three hours he was rubbed vigorously all over with a solution of salt and whiskey. He was conscious the whole time and in no pain. After a bit, with help, he was able to get up and walk about, but he was weak.

At eight, a man was at the front door with a message. Fire had been discovered again deep in the caisson roof. Roebling dressed and returned immediately to the caisson. He was down only a few minutes this time. The carpenters had drilled four feet into the overhead timbers and discovered that the whole fourth course of pine was a mass of living coals. The caisson would have to be flooded, Roebling said.

By half past three the caisson was entirely filled with water. It remained flooded for the next two days. Then the air pressure was restored, the water pushed out in about six hours. When Roebling and the others went down inside, everything seemed to be in order. But it had also been a brutal physical and mental ordeal for Roebling. He was a changed man after that, his assistants would say later.

By the first of June 1872, when the Chief Engineer issued his annual report, the Brooklyn tower stood 100 feet above the East River at high tide, while on the opposite shore the lower edge of the New York caisson rested 78 feet six inches below the same mark.

Work inside the New York caisson was to be finished in another month. So it was the end of the first great stage in the building of the bridge. From here on the problems to be overcome would be of an entirely different nature. Roebling made quite a point of this in his report, expressing congratulations to the Board of Directors "on the success which has attended the last of the two great tower foundations." The work to come—the building of the towers, the cable spinning, building the superstructure—was all work that had been done before on other bridges, on a smaller scale, "but upon the tower foundations rests the stability of the entire work." He added almost as an afterthought, "Considerable risk and some degree of uncertainty was necessarily involved in their construction."

One of the children to grow up on South Street in the 1870s was Al Smith, who would one day be almost as much a symbol of New York as the bridge itself. In later years he would describe his mother talking in tones of awe about the many workers who had died while struggling to sink the great caissons. "Perhaps if they had known," she had said, "they would never have built it."

Some time before the New York caisson was filled, Roebling suffered another attack of the bends. Who

was on hand to help him is not known. There would be nothing said of the incident in the papers. He himself made only the briefest mention of what happened in a report published later that fall. According to Emily Roebling, his condition was so serious during the night that he was expected to die before morning.

Yet on July 12 the filling in of the New York caisson was completed and apparently under the personal supervision of the Chief Engineer. The whole task of sinking the caisson had taken 221 days. In late November it was Roebling who ordered that work on the Brooklyn tower be suspended for the winter. The tower by then had reached a height of about 145 feet, or well beyond the level where the bridge deck would be. It was no longer a solid flat-topped shaft. Now the beginning of the great archways could be seen thrusting upward like three immense teeth separated by the two gaping spaces left for the roadways.

It was in December that work on the New York tower was halted, on account of the weather, at a height of nearly 60 feet. And it was in December that Washington Roebling found he was unable to go down to the bridge anymore. His condition was very serious now, extremely puzzling and a closely guarded secret. He tired rapidly. He was sick at his stomach much of the time. He became distraught over the slightest problems and slipped into moods of profound gloom.

By early spring, when the weather was such that the men could return to the towers, it was common knowledge that the Chief Engineer would not be resuming his command for some time. In April, Roebling formally requested a leave of absence. After a trip to Wiesbaden, he and Emily stayed for nearly three years in Trenton. The entire time the towers were being finished, the anchorages built, the cable-making machinery assembled, the Chief Engineer was nowhere near the bridge. Though the impression remains that at this time he kept watch from a window on Brooklyn Heights, his supervision of the job from Trenton was even more extraordinary.

Emily Roebling was nurse, secretary and emissary for her sick husband during construction of bridge.

When describing his own condition, Roebling does not seem to have used the words "bends" or "caisson sickness." He spoke only of a nervous disorder and of his crippled physical condition. There is every indication that the limits he had pushed himself to, the anguish of knowing so much about what ought to be done but being able to do so little—all that on top of the torment of the caisson sickness had brought on what in that day was called "nervous prostration."

Gray-faced, he would lie propped up in bed or sit like an old man in a chair by the window. Emily would sit close by taking down what he said. She was learning quite a lot about the engineering of a wire suspension bridge.

On August 14, 1876, he received a telegram: THE FIRST WIRE ROPE REACHED ITS POSITION AT ELEVEN AND ONE HALF O'CLOCK. WAS RAISED IN SIX MINUTES. Two other telegrams reported what he hoped they would: After the first rope, a second had gone across, the two to form an endless cable from anchorage to anchorage. It was a moment he had been anticipating for seven years and he had missed seeing it.

By the end of the first week in July 1877, all four cables were being strung simultaneously, and Roebling was watching the work himself. At the start of the month he and Emily had returned to Brooklyn. Now at last he was indeed at a bay window overlooking the river, following through field glasses the day-by-day progress being made.

Finished at last

In the early spring of 1883, about the time the weather had turned warm enough for the Chief Engineer to spend some time outdoors in the garden, the bridge was finished. There was no one moment when he could have said as much. Bridges did not end that way. There was always some last detail to attend to.

It had taken 14 years. In another few weeks he would be 46. He had spent nearly a third of his life on this one bridge, nearly as much time as his father had given to all his major bridges combined. He would live on, incredibly, to 89.

The nearer the end of the bridge came the better he felt. He could get about the house much more easily than before or go out into the garden. It was a little as

though he himself had returned from a long absence. He could read the papers again—about General George Crook chasing Apaches or about the housewarming party given by Mrs. William Vanderbilt.

In the time he had spent on the bridge, the telephone and the electric light had been introduced. Instead of one transcontinental railroad, there were now four and a fifth was under construction. The buffalo had been all but exterminated, and Chester A. Arthur was in the White House.

Emily, serving as her husband's principal contact with the work, was still going to the bridge regularly. In early May, when the roadway was at last completed, and the time had come to send a carriage across, Roebling asked that she be the first person to ride over. So one fine morning she and a coachman had crossed over from Brooklyn in a new victoria, its varnish gleaming in the sunshine. She carried a rooster as a symbol of victory and, from one end of the bridge to the other, men stopped work to cheer and lift their hats.

On Saturday night, May 19, to test the lights before the opening day, dynamos were turned on, and people returning to Brooklyn by ferry between 11 and midnight were suddenly astonished to behold overhead a great display of light from city to city. Whether they knew it or not, they were looking up at the future—steel and electricity.

It had been announced that the bridge would be thrown open to the public at the stroke of midnight May 24 and that anyone might cross upon payment of one cent. Enormous crowds had gathered at both ends. At 11:20 two young men with blond moustaches raised the windows of the Brooklyn tollbooths and H. R. Van Keuren—a good Brooklyn name, reporters decided—was the first to put his money in the box. The first lady to cross was a Mrs. C. G. Peck of Baltic Street. The first vehicle from the Brooklyn side was an old top-wagon drawn by a bony white horse whose hooves came down on the bridge with a noise like musketry.

People poured across the bridge through the entire night. According to the *Times,* the first beggar to cross came over from Brooklyn, as did the first drunk, the first policeman, the first hearse (empty), the first "dude," the first Negro and the first musician, a Scottish bagpiper. How late the Chief Engineer and his wife watched from their window as fireworks burst over the bridge that night can only be guessed at.

In another time, on a day when two men were walking on the moon, a very old woman on Long Island would tell reporters that the public excitement was not so much compared to what she had seen "on the day they opened the Brooklyn Bridge."

During the last part of bridge construction, Washington Roebling could only watch the work. His chief solace was a mineral collection, later given to Smithsonian. Above, President Chester A. Arthur (center) opens bridge.

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Book reviews

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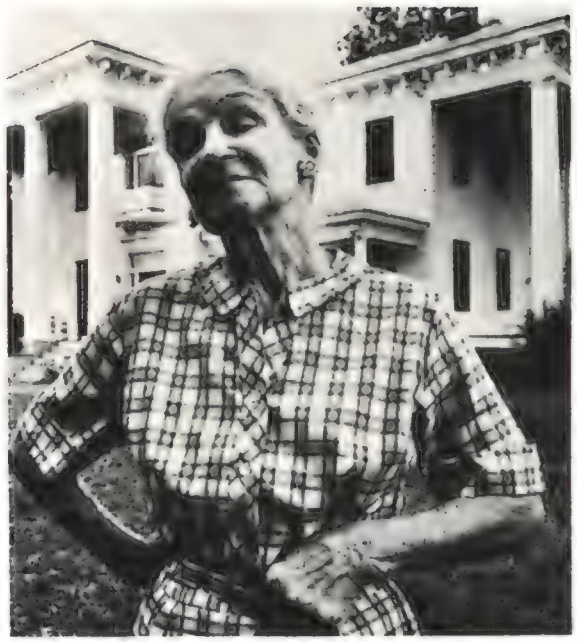

Mrs. Lois Starr: "People would like to buy 'The Columns.' But you don't sell things you inherit. . . . It's inheritance that gives you quality."

Mr. Covington and Mrs. Starr, The Marsh Taits and the Lev Sheffields, James McCoy, Mr. Richardson and Maggie Lee Pettway live down home in Wilcox County, Alabama. They live, too—burdened by a pervasive poverty, by pretentions and prejudices that shouldn't be—in *Down Home, Camden, Alabama* (McGraw-Hill, $17.50), Photographer Bob Adelman's black and white social portrait of a black and white county, still reliably Old South.

The citizens themselves have written the commentary. One of them, a black minister, has an answer: "A few funerals, and one or two other elections, and we're going to have a good county."

George the Third
Stanley Ayling
(Knopf, $12.50)

This book contradicts the myth of a mad old king whose chief claim to fame was that his intransigence drove the American colonies to revolution. He came to the English throne in 1760 and held it for 60 years—while ancient regimes all across Europe were collapsing. He was king during the thrust and fall of Napoleon, during a time of British territorial expansion—despite the loss of the 13 American colonies. Amid these forces, George III popularized the British monarchy.

Histories caricature him as a dunce or a despot: This biography leaves you thinking of Churchill. Far from being mad, the George that Ayling portrays was

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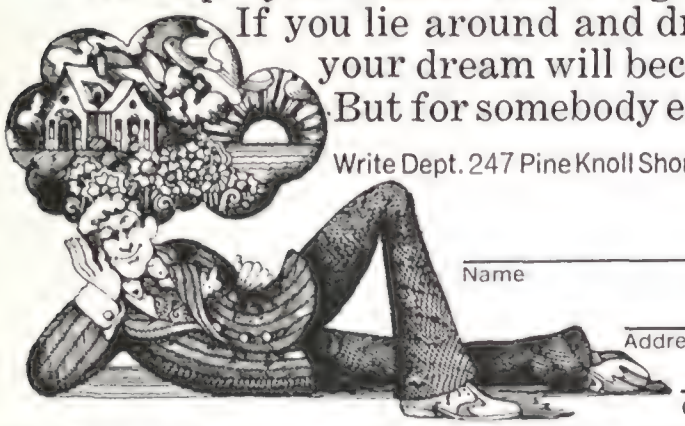

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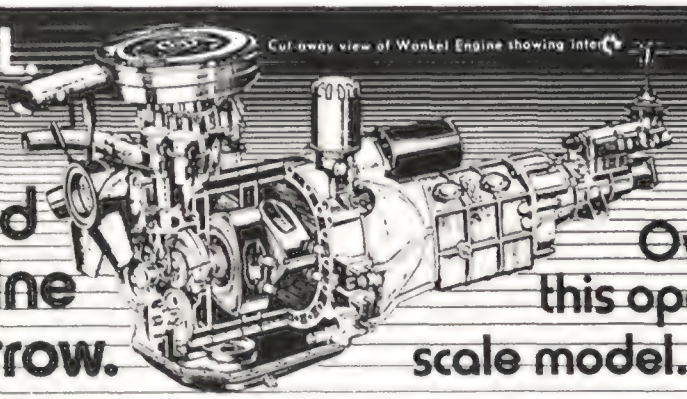

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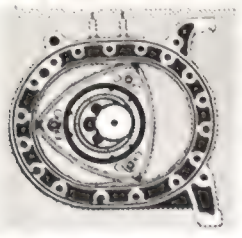

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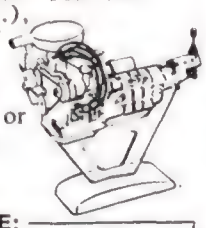

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shrewd, courageous and became one of Europe's ablest politicians—a thorough professional. He cherished the English Constitution and believed in constitutional monarchy and Protestant supremacy: After all, the House of Hanover had been called to the throne to protect both.

In an age when looseness was the license of the ruling class, George (it was said) had no mistress and so was thought eccentric. Other facets of his conduct were at odds with the social ambience of his era. It was a paradox that so conservative a king, with no vision of the future, could strengthen his position in an age of men of so eloquent a vision as Burke, Paine and Rousseau. But King George understood his people. Like all good Englishmen, he believed in honor, order, incessant work. He despised excess and prized courage.

He had a personal hand in everything, from grand strategy to the appointment of bishops. He could ride 60 miles in a day, and even when ill he sometimes walked eight miles a day. The sickness which left him blind, deaf and senile during his last ten years was diagnosed in 1966 as porphyria, a rare metabolic disorder. It's astonishing that any man could survive the "punishing palliatives and killing cures of Georgian medicine." They put the king into a straitjacket, set leeches on his temples and blistered the soles of his feet to relieve the pressure in his head.

His only indulgence was in the arts. He assembled a collection of 63,000 books for the new King's Library at Buckingham House. To house this legacy George IV began building what now is the British Museum. George III's devotion to Handel was "almost religious." When the Royal Academy was in dangerous debt, the king paid it himself.

As for the American Revolution, Ayling sets forth a roster of reasons for England's ironic defeats. George III was no warrior king; though he hated to lose, he came to believe a bad peace better than a bad war. Contrary to the opinion of American radicals, none of the British restrictions against the colonies was the work of "an unpopular home government serving a tyrannical royal master." Ayling writes that "they were strongly backed by such British public opinion as took any interest." Ayling cites Lord North's Quebec Act as "sound and liberal" statesmanship, not an act of hostility, and pointedly

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notes that certain Virginians, George Washington and Patrick Henry among them, saw their shares in the Pioneering Vandalia Company fall nearly to zero as a result of the Quebec Act.
—Nancy Poland
Former AP reporter, writer on Britain

The Great American Auto Repair Robbery
Donald A. Randall and
Arthur P. Glickman
(Charterhouse, $7.95)

A number of books by Ralph Nader and others bemoan the monumental mess we've got ourselves into with automobiles. By now, we all know the story only too well—too many cars, fatal crashes, pollution and all those repair bills.

But, what can we do about it?

Randall and Glickman provide a guerrilla handbook on how to fight back, how you can get your miscreant machine repaired and still keep your sanity and your wallet intact.

Most chapters are followed by a section tagged: "What You Should Do." At the end of the chapter, "The Man in the White Smock" (your smiling service manager), you are given steps on how *not* to take your heap in for repairs. Under step two, you are advised: "Don't tell the service writer what you think is wrong with your car. Instead, describe the symptoms." Under step four: "Don't sign repair orders that contain such vague work descriptions as 'check valves' or 'repair exhaust system.'" The book explains that you may only need a relatively inexpensive muffler, not an "exhaust system" which includes exhaust and tail pipes.

At the end of a chapter on "The Great Warranty Run-Around," Randall and Glickman tell how to buy a car with the idea of keeping warranty hassles at a minimum. Watch out for the price slasher, they say, because the more he shaves the price the more he cuts his repair shop budget. He wants to sell cars and has no intention of repairing your car under warranty. The book warns: "You might be better off paying more for a new car at a smaller dealership with a reputation for good service."

The authors advise against buying a car at the beginning of the model year. "Wait until the bugs are worked out," they say. You should also try to "avoid buying cars that are assembled on days before or after

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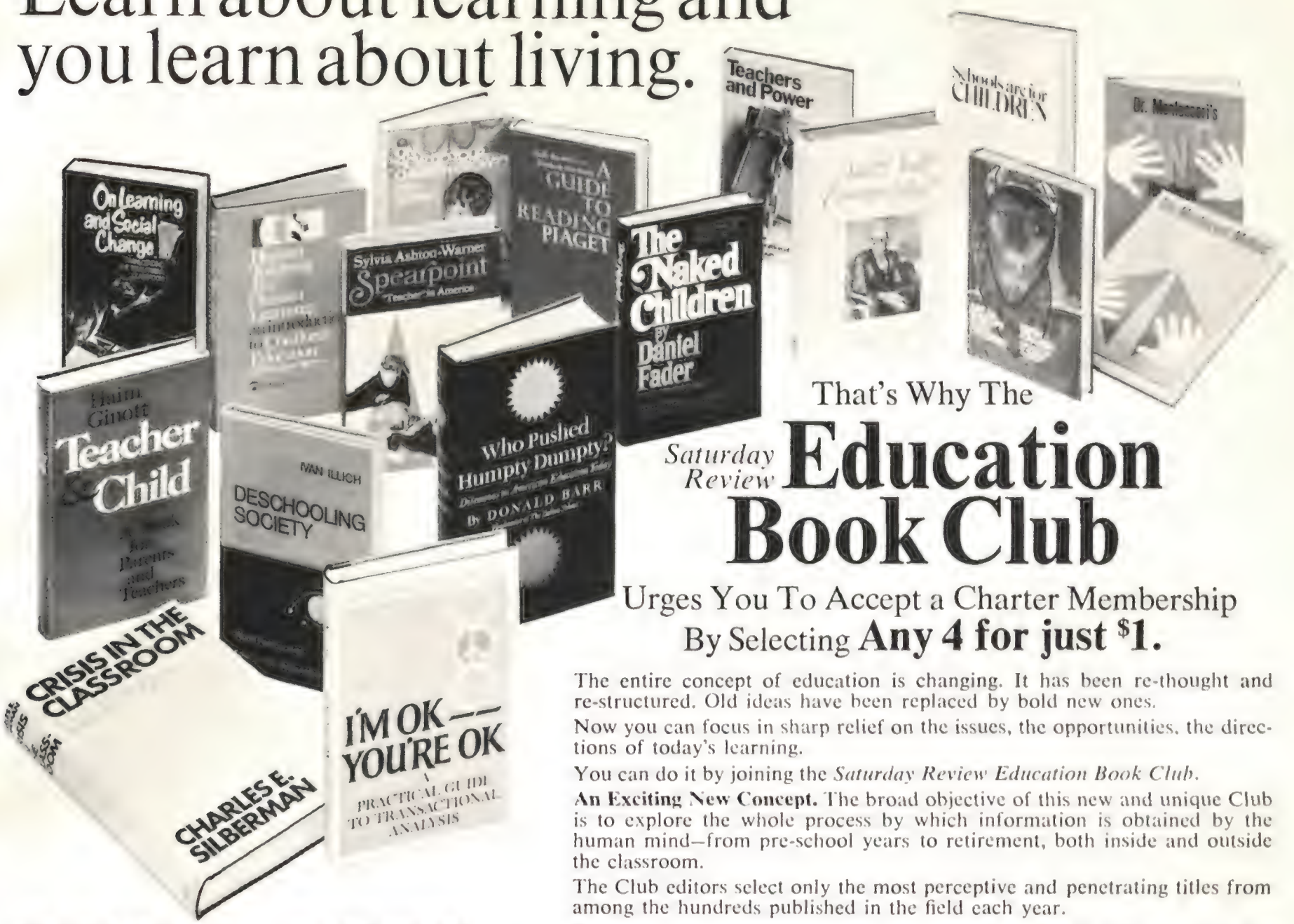

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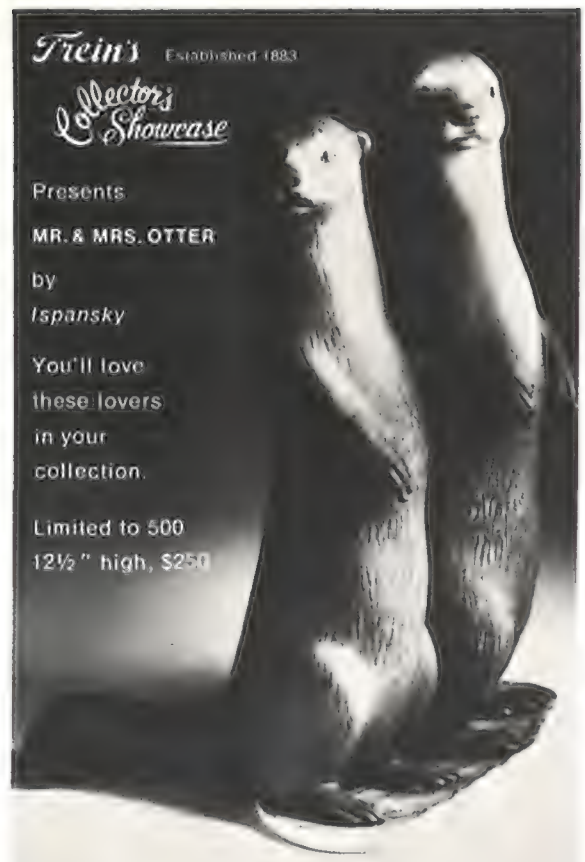

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Don Randall was staff counsel responsible for a four-year Senate subcommittee investigation into the darkest corners of the nation's repair shops. His conclusion? "If you haven't been gypped by an auto repair shop, it's probably because you have never driven a car."

—Peter Weaver
Syndicated consumer columnist

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Matt S. Meier and Feliciano Rivera
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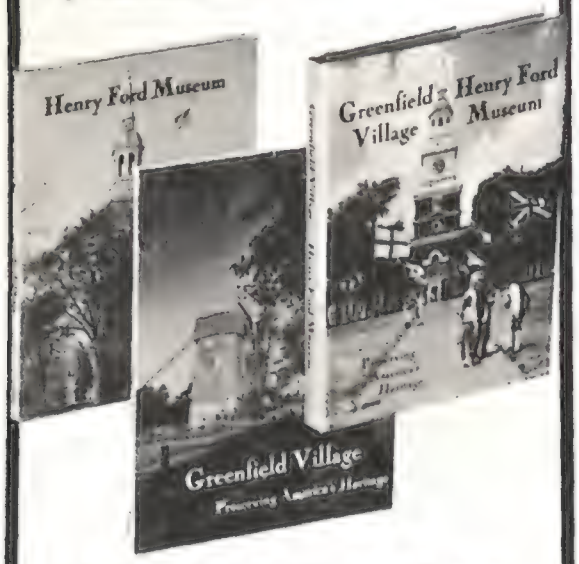

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vides a vivid historical perspective of our second-largest and fastest-growing minority group. Beginning with the early settlement of the Americas, the authors trace the evolution of today's Chicanos through five historical sequences: the Indo-Hispanic period, Mexican period, cultural conflicts of the latter 19th century, a resurgence in the first 40 years of this century, and a period of regeneration since World War II. The latter two sequences are among the most interesting since they deal with such incidents as the Delano strike, the illegal deportation of more than 200,000 Mexican-Americans to Mexico during the Great Depression and the gangs of U.S. sailors who roamed the streets of Los Angeles during the spring of 1943 attacking anyone who appeared to be of Mexican ancestry.

The authors see World War II as the turning point in the Mexican-American struggle for civil rights. A disproportionate number of Mexican-Americans enlisted or were drafted—many served with distinction and all received varying degrees of training and education. The war gave them political and economic awareness. But on returning home, they found themselves "still limited to the poorest-paying jobs . . . most dilapidated housing and with only limited access to education and other public services." Naturally, the ex-GIs found this intolerable and the period of regeneration began.

The book closes with brief profiles of today's best-known Chicano leaders. Many Anglo-American readers will be surprised to learn the Chicano leadership is not youthful, but middle-aged. Most are World War II or Korean war veterans who returned to build a better life for their people.

—Stephen Green

Aide to Senator Alan Cranston of California; writing a book on the Indian press.

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Smithsonian

Index

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Yet EQM is still new and relatively unknown, so we can't ask people to subscribe on faith alone. So, here's what we had in mind: Send us your name and address and we'll send you our latest issue. If you don't like it tell us within 15 days–and we'll take you off the hook–no hard feelings. If you do like it, you'll get 12 monthly issues for the modest sum of $10.00, saving $2.00 off our regular newsstand price.

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Domestic Tours for Associates

Study tours are designed as educational travel for members of the Smithsonian Associates. Smithsonian staff or other experts accompany all tours. For information: Mrs. Patricia Kilkenny, Room 106 SI, Smithsonian Institution, Washington, D.C. 20560. (For foreign study tour information, see page 18.)

Blockade-Runners' View of the Carolinas: Coastal traverse, including visits to a shipwreck, maritime collections, Fort Fisher and Civil War period buildings and gardens—October 21-27.

Sanibel Island, Florida: Exploration of a Gulf Coast barrier island and the wildlife refuge—November 5-10.

Nature's Past: A view of the preserved natural areas of Florida's west coast, starting on Sanibel Island and ranging from the flood plain valley of the Myakka River through jungle and cypress swamp—November 12-19.

Christmas at the Smithsonian: Second in a series of weekends for the National Associates, featuring activities and personnel of the Smithsonian Institution. A Bach concert, private showing at museum shops, tours of the Renwick, tree decorating, and an orientation reception and dinner are part of the program. December 15-17.

Apollo 17 Space Launch: A four-day trip to Cape Kennedy to witness the last scheduled launching of an Apollo moon mission. Tour includes briefing and guided tour of NASA facilities. (Preference will be given to Associates who have not been on previous Apollo trips.) December 3-7.

California Mission Trail: History, art and architecture on the route followed by Franciscan missionaries between 1769 and 1823—January 13-19, 1973.

Birds of North Carolina: Observation of waterfowl at Mattamuskeet Wildlife Refuge—February 1973.

Baja California Whale Migration: mid-February 1973.

Smithsonian highlights

Division of Performing Arts
For ticket information on the following presentations, call (202) 381-5395.

"Lee Konitz—Saxophonist" begins the series of jazz heritage concerts, featuring all styles and periods of jazz. The concert is on October 8 in the Museum of Natural History Auditorium, 8 P.M.

"Music of South India," played, sung and danced. Performances are on October 11 and 12 at 8:30 P.M. in the Museum of Natural History Auditorium.

"American Grass Roots Guitar" features Doc Watson at 8:30 P.M., October 14, Museum of Natural History Auditorium.

"Music from Marlboro," the opening concert of the chamber concert series, is at 5:30 P.M. on October 20 in the Museum of Natural History Auditorium.

"Music of the 19th Century" presents the Camerata Chorus of Washington in the Grand Salon of the Renwick Gallery. The concert is on October 30 at 8 P.M.

"The Hullabaloo Election of Osbert or Jess" continues at the puppet theater. Performances are at 10:30 and 11:30, Wednesday through Friday, and at 10:30, 12:30 and 2:30, Saturday and Sunday.

Museum of Natural History
"The Shadow of a Stone-Age Man" sheds light on a culture 30,000 years old, with unique soil shadow (three-dimensional body cast) of Paleolithic hunter (see September SMITHSONIAN) found in northern Spain, with grave offerings.

Renwick Gallery
"American Pieced Quilts" illustrates the artistry and beauty of this folk craft. The 45 pieced quilts, most of them from the 19th century, and 50 colored slides will be circulated nationally by the Smithsonian Institution Traveling Exhibition Service after the U. S. premiere at the Renwick in mid-October.

National Collection of Fine Arts
"Solon Borglum (1868-1922)" displays the work of this American artist known for his sculptures of Western figures—Indians and cowboys. Opens October 20.

"Countryside/Inner City" contrasts rural and urban landscape and people in photographs of George Washington University and Goddard College and their students, at Discover Gallery.

"The Way of Good and Evil: Popular Religious Lithographs of 19th-Century America" includes 56 prints based on biblical scenes, moralizing themes and the temperance movement.

"The Hand and the Spirit: The Religious Impulse in American Art, 1700-1900" features some 120 paintings and sculptures representing biblical events and characters and the 19th-century concept of Man's oneness with nature.

Arts and Industries
"The Flying Tigers" features portraits and memorabilia of the American Volunteer Group, forerunner of U.S. planes in the Pacific theater in World War II.

Museum of History and Technology
"The Atlantic Cable" evokes through paintings, photographs and artifacts a technical triumph—the first undersea cable which linked North America with Europe in 1858.

Smithsonian Associates
"Museum Reference Service" now provides listings of outstanding museums and galleries for every state to Smithsonian Associates upon written request (allow a minimum of three weeks for mailing). Brochures are included whenever possible. Write: Smithsonian Associates' Museum Reference Service, Associates' Reception Center, Smithsonian Institution Building, 1000 Jefferson Drive, S.W., Washington, D.C. 20560.

The Whitney Museum of American Art's "New American Filmmakers Series" opens October 10 with showings at 7 and 9 P.M. in the Museum of Natural History Auditorium, and continues on this schedule each Tuesday. Beginning October 15, and continuing each Sunday, the week's program is shown at 5:30 P.M. in the Museum of History and Technology. For ticket information, call (202) 381-5157.

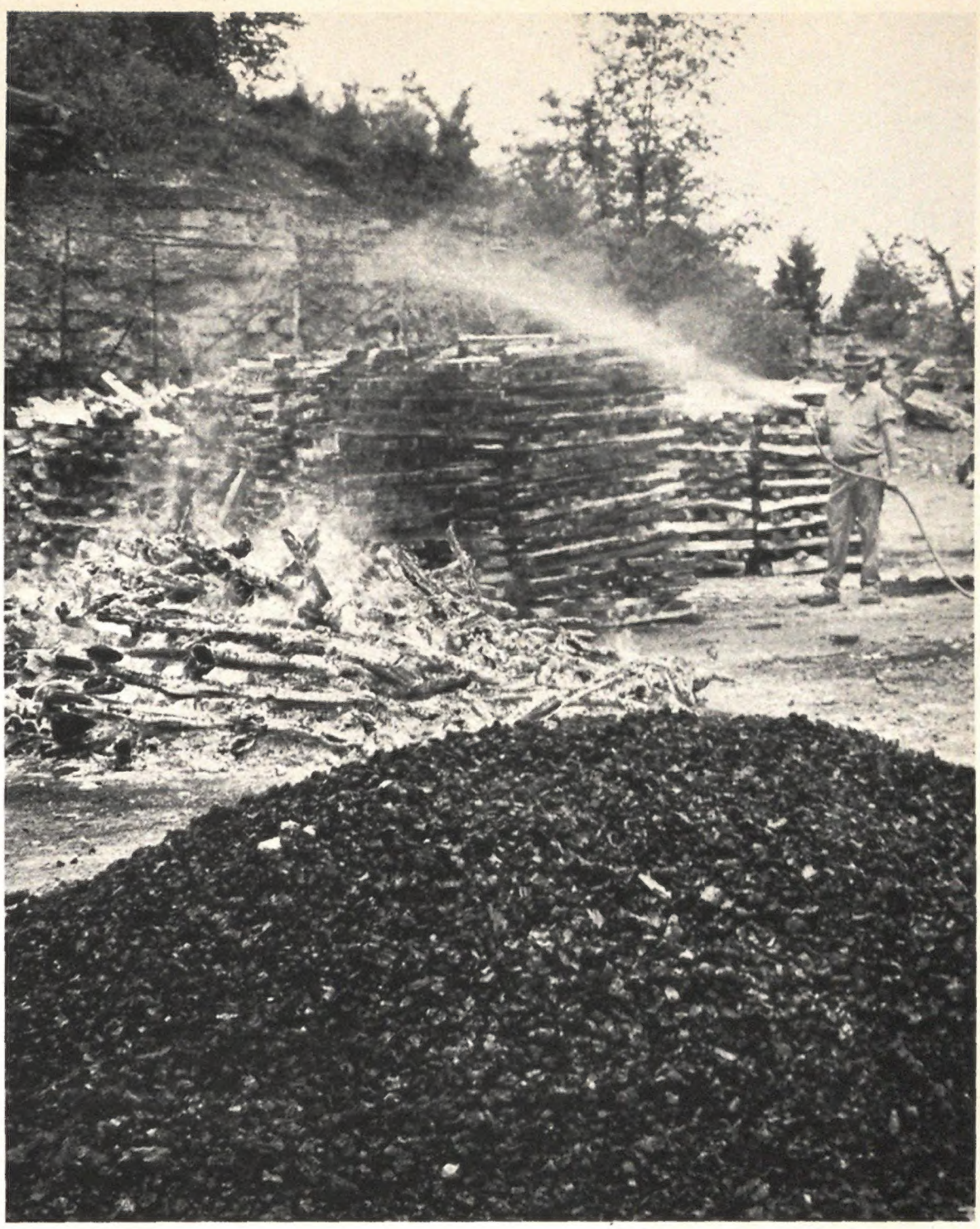
National Portrait Gallery
"Red Groom's Sculpture of Dave Scott on the Moon" is an 11-foot-tall work of wood, cloth, acrylic and plastic.

Anacostia Neighborhood Museum
"Evolution of a Community (II)," the second in a series of exhibits on Anacostia, deals with community problems.

Traveling Exhibition Service
There are up to 70 different Smithsonian-sponsored exhibitions on display each month throughout the United States and Canada. For a complete listing and information on how to bring an exhibit to your area write: Traveling Exhibition Service, Smithsonian Institution, Washington, D.C. 20560.

- Columbia, S.C.—"William H. Johnson" (Columbia Museum of Art, Oct. 1-Nov. 12).
- Sweet Briar, Va.—"Contemporary Chinese Brushwork" (Sweet Briar College, Oct. 7-Nov. 5).
- Storrs, Conn.—"The Monotype: An Addition of One" (William Benton Museum of Art, Oct. 14-Nov. 12.
- Tampa, Fla.—"The Genteel Female" (Tampa Bay Art Center, Oct. 7-Nov. 5).
- North Newton, Kans.—"Embroideries by Children of Chijnaya" (Bethel College, Oct. 14-Nov. 12).
- Santa Barbara, Calif.—"Photographs of a New Guinea People" (University of California, Oct. 7-Nov. 5).
- Newark, Del.—"Two Greek Photographers" (University of Delaware, Oct. 14-Nov. 12).

Smithsonian Commons
Luncheon facilities for members of the Smithsonian Associates are in the original Smithsonian Building. Open weekdays from 11:30 A.M. to 2 P.M., the Commons offers a buffet luncheon from $1.40 to $1.85 upon presentation of a membership card.



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By Patrick Ryan

There's always another day—or is there?

After, of course, a few chivalrous words of welcome, probably the first thing Adam said to Eve was, "I've got a funny feeling that it's going to be the end of the world tomorrow." And fairly regularly ever since, some soothsayer or another has been forecasting imminent doomsday for Homo sapiens.

Apocalyptic prophets such as Daniel and Isaiah devoted much of their sermons to warning the populace that the day of wrath was just around the corner. Rabbinical legend held that the world would last 6,000 "years," although nobody seems quite certain about the length of those mystagogic years.

Samuel Pepys recorded in his diary on November 25, 1662, that some of the "Fanatiques" were predicting the end of the world for the coming Tuesday. But on that fateful day, his only entry of moment was to inform posterity that for the first time that winter he wore a "wastecoate." An early leader of Jehovah's Witnesses prophetically wrote off the rest of us in 1914; having drawn a partial blank in that year, they now seem to have us booked for oblivion before 1975.

And today in any capital city connoisseurs of Speakers' Corners can always encounter a couple of bright, smiling prophets bearing plastic banners advising urgent repentance because the day of Judgment is nearer than you think.

The poets, while lacking religious certitude about dates, have suggested various manners in which the human race will be offered its final hat. Alexander Pope took a somewhat theatrical view of the event: "Thy hand, great Anarch! lets the curtain fall,/And universal darkness buries all." And T. S. Eliot's current chill prognostic was that "This is the way the world ends/Not with a bang but a whimper."

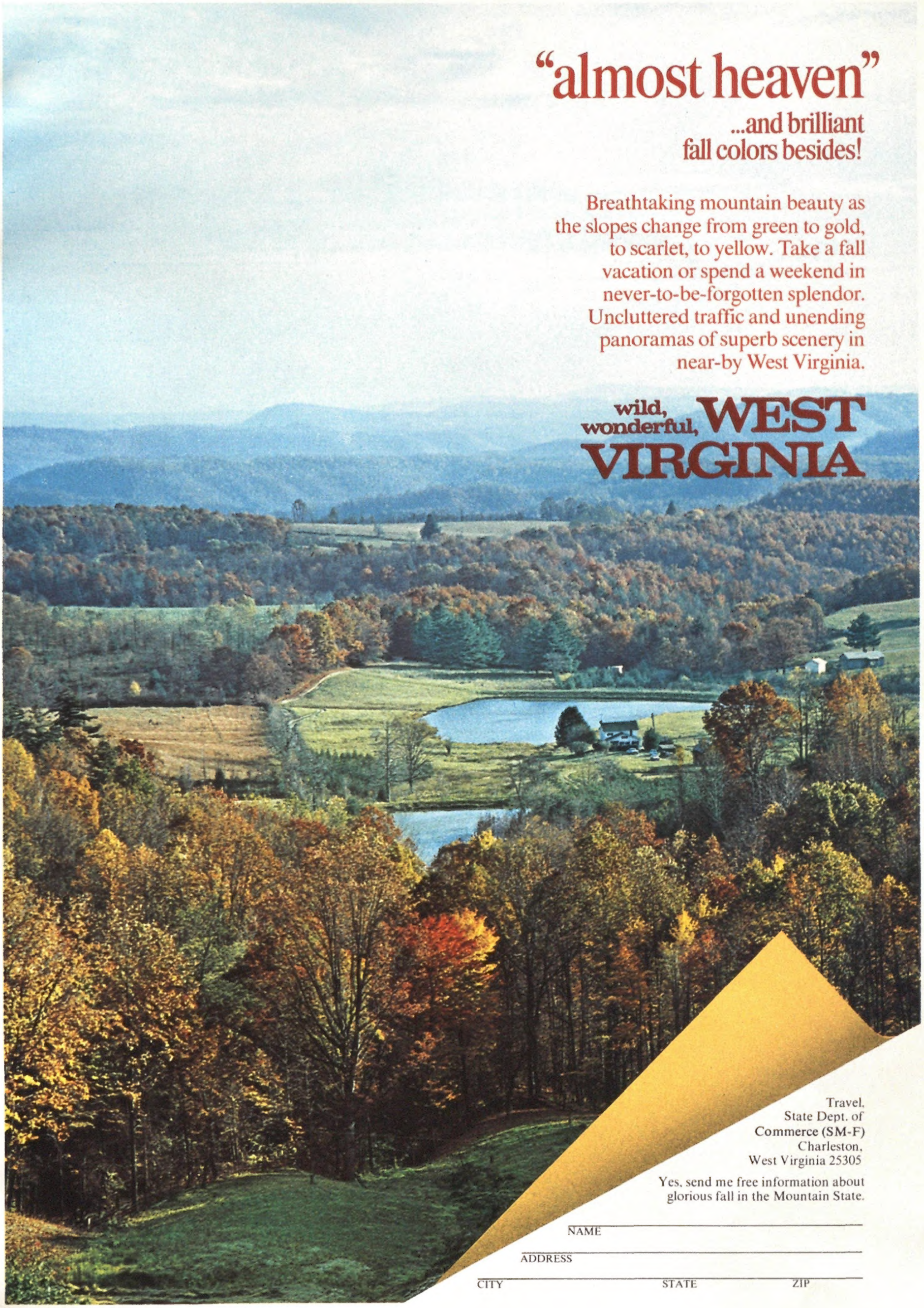
Soothsaying scientists, taking them a bit by and large, come in two broad premonitory persuasions: one which has us marked down for an eventual astronomical end, and the other which threatens us with more immediate technological suicide. The former group of eschatologists contends that the sun is but a "dying star," currently at the yellow dwarf stage and burning up its stock of hydrogen at a rate of five million tons a second. But the five-billion-year-old sun has a couple of stages and 30 billion years to go before it dims at the black dwarf stage. The Earth, meanwhile, has less time (only six billion years) before it is cremated by the sun in its red giant stage.

The other, more speedily doomful tribe of scientists forecasts that unless we forthwith put the brakes on our material progress, we are going to rub ourselves out of existence before any of the Four Horsemen of the Apocalypse can get a boot on. Though all are unanimous that extinction is coming up like thunder, there is some dissension among competing calamitous factions as to whether it will be through destruction of the ecosphere by pollution of air, sea and land, genocide by pesticide, or whatever.

But, however it may happen, we are certainly going to miss having the end to look forward to. The Ultimate Catastrophe has long served as a touchstone of solace against which any current tribulation could be viewed as a comparative delight. However parlous your plight, it wasn't the end of the world, was it? The poor, the humble and the henpecked have ever been encouraged to bear their trials patiently by the prospect that all accounts would be balanced on Judgment Day. And the unfulfilled possibility of Armageddon has always been a consolation in childhood to those facing a morning of unprepared examinations, dental appointments or parental retribution.

Statistically, the arrival of such a convenient cataclysm was always rather a long shot because, whatever else it may lack, our world distinctly has stamina.

The Earth's crust is guessed to be about five billion years old, life has been upon it for one or two billion years and men, albeit a bit low in the brow and vast in the jaw at the outset, have been padding around for half a million years or so. Tomorrow, and tomorrow, and tomorrow, forecast Macbeth; world without end, amen, echoed the multitude; and the ever-adaptable naked apes, aided perhaps by interplanetary emigration, may yet defy the doomsayers and persist like transgalactic Whiffenpoofs from here to eternity. Providing, of course, that the end of the world doesn't actually intervene before I finish writing this. . . .



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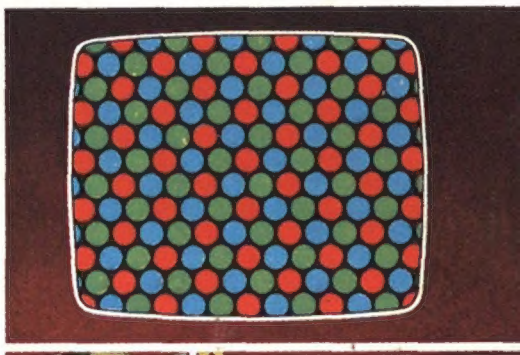

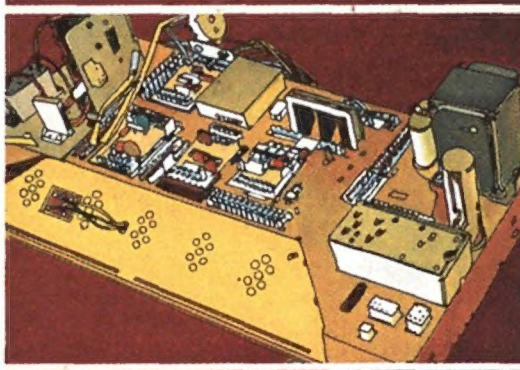

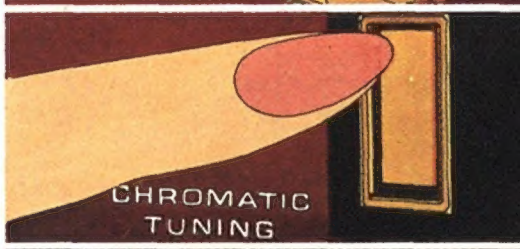

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